THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE GRANTHAM RAILWAY ACCIDENT.

THE recent railway accident at Grantham furnishes another sad instance of the dangers attendant upon the traveller by railway, and calls for the utmost sympathy with the unfortunate sufferers and their friends. Up to the present the immediate causes of the accident are unknown, and it is probable that the deaths of the unfortunate driver and fireman will prevent the exact events leading to the disaster from ever being known.

It is not desirable at this time to attempt to apportion blame for the occurrence. The official inquiry by Colonel Von Donop on behalf of the Board of Trade, may be relied upon to elicit all the evidence available. For the reason given above, such evidence as may be available can only be of an indirect character. Conjecture has been rife as to which of numerous imaginary defects of train equipment, on the one hand, and mental and physical conditions of the driver and fireman on the other hand, are most likely to have been responsible for the accident.

Whilst not asserting that any evidence exists to prove that the accident was due to defective human control, it may be pointed out how, to a certain extent, the preliminary occurrences to the final disaster approximate to the circumstances attending the Slough accident of two or three years ago. In that case the driver neglected and ran past more than one set of signals at danger, in broad daylight, and it was only when too late that the fireman called his attention to the signals being at danger. No satisfactory explanation was ever given for the signals being neglected, but there is no reason to doubt that pre-occupation of mind had led to temporary obliviousness to the things immediately surrounding him. The Slough accident and others which it is unnecessary to recall, simply prove that man is not at all times able to concentrate his attention on even the most important duties. When his actions are of the monotonous sameness of those of a long-distance express engine driver, and the other conditions of his work are taken into account, little wonder need be felt that at times his attention wanders. The infrequency of accidents traceable to such a cause is the best testimony to the vigilance of drivers. The danger, however, is always there; the question for immediate consideration is what remedy can be provided for such a condition of things.

Of late years the question of delivering signals in the engine cab has attracted very considerable attention in this country, and at the present time several railway companies are experimenting with apparatus intended more or less completely to advise drivers of the positions of signals that govern their progress. The more forcibly these indications are brought to the attention of the driver the better, and the more completely they supply the whole of the information the driver ordinarily obtains from the line signals, the more valuable they will be. Not the least valuable of such

indications would be one which informs the driver that he is approaching a signal, in time to draw his special attention to that signal. Whilst such apparatus as is here referred to has been mainly devised with a view to supplementing the line signals during fog when the latter are not readily visible, the Slough accident (and it may be those at Salisbury and Grantham) shows that there is need for some such apparatus to be continually in use. Apparatus that will rouse a driver from a reverie which prevents him from paying due attention to his duty, has a real value in view of such occurrences as have followed involuntary inattention.

Too much stress should not be laid upon the fact that there are two men on an engine, and that, therefore, the neglect of one of them may be neutralised by the other. The duties of the driver and fireman on a train are entirely different in character, and on fast heavy trains the duties of either absorb all his energy. The fireman's physical duties are especially heavy, and he has little or no time to assist the driver in looking out for signals. What little time he may have may not be at the time when extra vigilance on his part would neutralise inattention on the part of the driver. Moreover, engine cabs are not, and cannot be, lighted in such a way that inattention on the driver's part will be readily noticeable at night-time, and it is by no means easy at any time to say that a driver, occupying his usual position, is or is not paying due attention to his duties.

It may be pointed out that the accident was really apparently due to the train taking a curve at too high a speed, and that that curve was not on the line on which the train would have continued its journey in the ordinary course of things. Assuming that the train was "accepted" by the signalman into the station section, the question why the points were set for the Nottingham line instead of for the North, becomes of importance, but a satisfactory answer to this question has not transpired. Had the points been set for the continued journey of the train, the probability of a serious accident occurring would have been remote, assuming, of course, that the driver had found his position. The setting of the points for the continued journey of the unfortunate train was quite the proper thing to do, as a reference to the regulations governing the giving of the "line clear" signal will show.

The severe condemnation of the use of gas for lighting trains which was uttered by the Board of Trade inspector in the case of the accident at Slough will doubtless be echoed in the report on the present disaster. Beyond all question, the most ghastly feature of these terrible catastrophes is the fact that some of the victims are roasted alive, in the sight of would-be rescuers. These shocking scenes will continue to recur until railway companies entirely give up the use of gas for train lighting and adopt one or other of the many excellent electrical systems which have been developed for this purpose. Let them be wise in time. We do not like compulsion, but inevitably the Board of Trade will resort to this in the end, if the companies do not take the necessary steps voluntarily.

The Halifax Tramways Strike.

The Halifax Tramways strike is now virtually over; although some 150 of the strikers are still out, their places are practically filled by men who are daily becoming competent for their posts, and these are being helped on by the efficiency of 28 motormen and 15 conductors who have gone back to their employment, and by the eight motormen and seven conductors who refused to come out on strike. It is a fact remarkably suggestive that about one-half of the present employés on the Halifax Tramways are Halifax men. The number of men who gave in their notices was 225; these men were guided by the collective results of the so-called ballot which was admittedly not a ballot at all, as the men, by an unheard of process in the annals of a "ballot," had to sign their names, and this precluded that action and pledge of secrecy which is the spirit and aim of a ballot. It is admitted by the Halifax public, apart from the section who cleave to the action of the Labour party and their leaders, that if the secrecy of the ballot had been genuine and thorough, there would have been no strike until more time had been devoted to trying to get their demands by friendly negotiation with the Tramways Committee, or in the event of failure from that quarter, by an appeal to the municipality. The demands of the strikers were formulated under three heads: (1) The re-instatement of Driver Chadwick; (2) a week's holiday per annum with pay; (3) an improvement in the conditions of service. The first demand has already been relinquished for reasons which appear in the official report as to the tramway disaster which occurred on June 20th last where Chadwick was the driver of the car. With regard to the week's holiday question, it was admittedly a subject for further negotiation, and in case of failure for appeal to the Town Council, and as regards the demand for better conditions of service, the same argument is equally applicable. In short, the strike was precipitate, hasty and ill-advised on all grounds of equity and commonsense, and it has proved unfortunate not only for the strikers, but eventually more so for the local Labour party, who will feel its effects in the future more than the present sufferers. Mr. J. H. Palin, the branch secretary, in his letter of May 31st last formulating the grievances of the men in stating the demand with regard to wages, has the following clause in his letter to the Tramways Committee. He says:—

> In this connection we frankly acknowledge that your Committee so far as the drivers are concerned behaved most generously in the past in paying a rate of wages which we could hold up to other Corporations as a commendable example which they might well follow, with the result that you have secured a body of men of whom you may be justly proud, inasmuch that Halifax is, and always has been, almost immune from serious accidents, which is all the more remarkable in view of the heavy gradients and narrow streets which are to be found upon nearly every route upon your system.

Seeing that these drivers and motormen were so well paid for work to which they had served no apprenticeship, but had received their instruction from their employers, it surely ought to have led the local Labour leaders to advise the men to pause, and to urge prolonged attempts at conciliation as regards the "low pay" for the car-cleaners and undermen, instead of countenancing a strike and including in this the admittedly well-paid drivers. For the 26 weeks, February to August 28th, the average earnings of the motormen amount to 33s. 7d. per week; the average earnings of the conductors were 24s. 11d. for the same period, and of the car-cleaners 27s. 7d.; these are facts, stubborn facts, and despite Labour principles and views they have great weight with the working men of Halifax. The whole question and cause of the strike is an unfortunate business, and the Labour party who have strongly supported the strike, may well reflect on the results of their indiscreet intervention. One result may be accepted with confidence, namely, it will be a long time before Halifax Tramway employés again accept the guidance of the Labour leaders in a like contingency.

The Higher Fares on the District.

There could be no more typical instance of the loose economic thinking that characterises such a great deal in modern movements political and social, than the agitation which has arisen over the legitimate raising of fares upon the District Railway. From the remarks made one would imagine that a combine as ruthless as the Beef or Ice Trusts across the Atlantic had, after securing opulent dividends, given another turn to the screw. As a matter of fact, fares were reduced to too low a level, probably in a panic miscalculation. Having enjoyed the fruits of travelling at less than cost price (less, that is, when legitimate allowance is made for interest on capital expended), travellers, feeling naturally irate at increased fares, are protesting in a wholly indiscriminate and exaggerated fashion. We would put a query to the non-technical daily Press which is voicing these protests. Assume that a

tradesman wishing to advertise himself, or, perhaps, to drive a competitor off the field, sells tea or meat to his customers for a certain period at an unremunerative price. Realising the futile fatuousness of such a policy, he ends what his customers think a glorious era by reverting to slightly higher prices. Do his customers then hold meetings of protest and write to the papers about the iniquity of his refusing to follow a policy which will drive him into the bankruptcy court? Or, during a period of high metal prices, such as the present, do our leading firms of cable-makers hold indignation meetings, and ask for Government interference because copper, tin, and steel cost more than they did two years ago? The action of the railway directorate in raising fares is quite legitimate. Ill-balanced minds have, however, assumed that sections of the general public have a right to certain facilities of transport at less than cost price, and they agitate accordingly.

More sound business-thinking is certainly a need of the age. We do not imagine that the Socialist demands which are becoming so persistent, will do much towards affording clear economic considerations of financial operations. No section of the community has any moral right to demand that it shall travel at less than the actual cost, the deficit being thrown either upon shareholders or ratepayers. In the case, for instance, of cheap fares for workmen upon early morning trains or tramcars, it is not enough to take the cost of an average passenger train-mile, or car-mile, and by reckoning the receipts of the train or car conveying workpeople, declare that such traffic yields a profit. If the community decides that the evil effects of overcrowding in slum areas are best met by conveying part of the community at less than cost price from distant suburbs to its daily occupation, such a policy should demand specific grants in and from the rates, and not be met by extortion from the shareholders of a railway company or by a *disguised* taxing of the ratepayers to afford such facilities. But no section of the community should be subsidised at the expense of the rest.

The fares are still, we believe, less than a ½d. per mile in many cases, and are far lower than they used to be before electrical working was adopted. It is alleged, with much plausibility, that suburban building agencies, which have been reaping a golden harvest during the last few years, are largely responsible for the agitation.

The Wireless Conference.

On Wednesday the International Conference on Wireless Telegraphy commenced its sittings at Berlin. The avowed object of the German Government in convening the congress is mainly to arrive at an international agreement for the regulation of wireless telegraphy at sea; but the real root of the matter lies far deeper. The fact is that the Marconi International Marine Communication Co. has established its system so firmly throughout the world, by enterprise for which it deserves due credit, that the German Government has been obliged again to come to the assistance of its protégé, the Telefunken Co. The Marconi company steadfastly refuses to allow its stations, or ships equipped with its apparatus, to communicate with ships or stations employing any of the rival systems, and this embargo extends also to the stations of Lloyd's Shipping Agency, and even to British warships, thanks to the agreement concluded between the Admiralty and the Marconi interests in 1903.

The desire of the German Government, therefore, is to break down the monopoly which has been established in effect by the Marconi companies, by securing an international agreement to compel all wireless stations and ship installations to communicate indiscriminately with all others within their range, thus placing all systems on an equal footing. The British and Italian Governments, however, which led the way in fostering the development of wireless telegraphy, are not likely to accept any such proposal—even were their hands not bound by their agreements with the Marconi companies. It is not unusual, we believe, for the British Government to sacrifice the interests of the nation with the vain hope of promoting kindly feelings on the part of its rivals; but in the present instance such a proceeding would be so unpopular, even with the party in power, that the precedent instituted at the conference of 1903 will, in all probability, be followed, and the result will be that nothing will happen.

ELECTRO-MAGNETIC CONTROL OF GOVERNORS.

By HARRY R. SPEYER.

Central stations supplying energy for light, power and traction must necessarily have, when running alternating and continuous-current machines coupled up to the same engine, some means or other for steadying the bus-bar pressure; otherwise serious fluctuations will be set up in the voltage, due to the rapid variation of the traction load.

It has generally been the custom in the past to prevent this dropping of the bus-bar pressure by employing a battery and "boosting" machine. The extra apparatus not only increases the first cost of the station, but as the battery, in order to be kept in first-class working condition, requires constant and careful attention, it forms a large item in the running and maintenance costs of the station.

The above method of keeping the voltage constant may be replaced by another, in which an electro-magnetic coil is

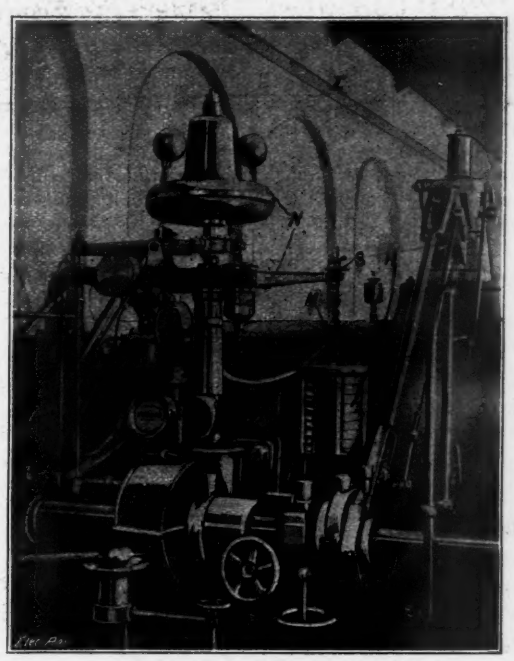


Fig. 1.

attached to one end of the lever of the engine governor (fig. 1). The working of this arrangement is as follows:—

The current in flowing back from the traction load to the negative terminal of the dynamo is passed round the electro-magnet H, with the result that the core M is pulled down to a greater or less extent according to the strength of current flowing through its coils, or, in other words, the amount the core M will be pulled down is directly proportional to the load.

As seen from fig. 1, this core M is attached to the governor (N) in such a way as to help it in its working, with the result that the opening and closing of the steam admission valves, corresponding to the varying load, is regulated in a far shorter time than is possible when the mechanical governor is used alone.

It is not really necessary for the whole amount of current passing in the return cable to be sent through the electro-magnet; a certain percentage of it will do the work just as well. This percentage can only be found by experimenting, and mainly depends upon the manner of working, and the kind of governor in use, as well as upon the effect the coil is intended to exert.

Looking at fig. 2 (p. 524), without the use of the electro-magnet, the speed of the engine, as the load increases, will gradually fall from the normal speed of 90 to 86 r.p.m. (Curve A), with the result that there will be a corresponding percentage

drop in the voltage; now, one can design the electro-magnet, either with strength enough to pull down the governor to such an extent that the revolutions of the engine at full-load are the same as at no-load (Curve B), or with such a strength that with the increase of load, the revolutions of the engine are also increased (Curve C). In both

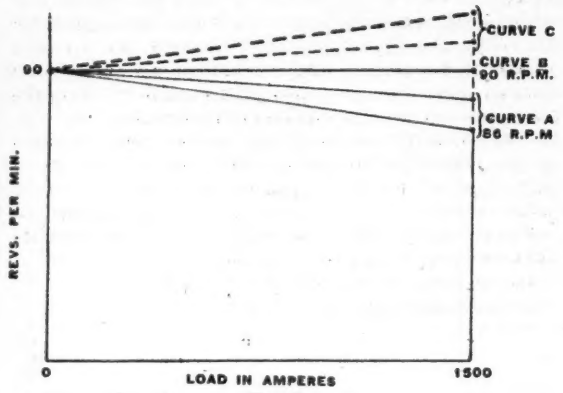


Fig. 2.

cases the number of turns in the coil can remain the same, the difference being brought about by sending a greater or smaller proportion of the return current through the electro-magnet.

When only a portion, and not the whole amount of current is used, the electro-magnet is connected up to a part of the circuit as a shunt.

At the Wiesbaden Central Station, which was the first one to adopt this method of regulation, only one-seventh part of the total current is used, this proportion being found to give the best results.

Though this method of keeping the bus-bar pressure constant possesses the distinct advantage of doing away with a battery, it does not allow one to run the engine and work the boilers at their most economical and constant load, with the result that there may, perhaps, be a greater coal consumption than when one is working with a battery; for with the latter it is possible to have constant steady load on

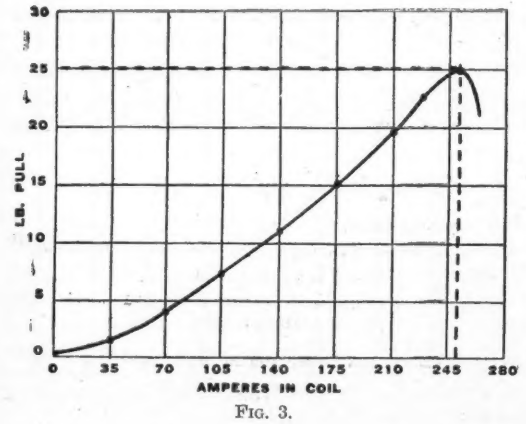


Fig. 3.

the engine, and to arrange for the extra load to be taken up by the battery. Therefore, in comparing the two methods, one of the points that has to be considered is whether the possible extra coal expenses of the station will come out higher than those rightly chargeable to the maintenance of the battery, and if they do so, one must further consider whether the results achieved are worthy of this extra expenditure.

In fig. 3 we have a curve showing the relation between the current circulating in the magnet coil, and the pull in lb. that it exerts. The greatest pull that the magnet can exert on the core takes place when the distance between the centre of the magnetic coil and that of the core is, between certain fixed limits, a maximum. When these two centres come together, the core will lie in a neutral magnetic field, with the result that the pull which the coil can exert upon it will rapidly fall away. Should the core be allowed to pass the middle of the coil it would no longer be attracted but repelled, with the result that it would then act against the mechanical governor, and prevent the engine from being overloaded.

The core M, which can be adjusted by the small wheel S, should be so set that it only reaches the middle of the coil when the engine is fully loaded with the greatest allowable load. On looking at the curve (fig. 3) which has been drawn from the results obtained in a central station, it will be seen that when the maximum current of 250 amperes (corresponding to the highest load likely to come on the engine during peak hours) is flowing through the coil, there will be a maximum pull of 25 lb.

It must not be forgotten that the coil acts *–before* the influence of the growing load has made itself felt in the revolutions of the engine, and thus before the voltage has had time to fluctuate.

This method of voltage regulation has been adopted in the Wiesbaden central station with the most satisfactory results. Before its use, in order that the fluctuations in the voltage should not be excessive, it was always necessary to run two sets of machines—one for lighting and the other for power. Now, with the use of the electro-magnetic regulator, it is quite an easy matter, without employing a battery or booster, to keep the voltage constant, in spite of the fact that only one machine may be running for supplying energy for both light and power.

The variation in the traction load may be anything from 100 to 700 KW., and with this there is never more than a 3 per cent. pressure drop on the 600-volt tramway system.

On the low-pressure side of the alternating-current plant for lighting purposes, &c., the voltage drop never exceeds more than 2 per cent., and, as the engines are supplied with large and heavy fly-wheels, this drop occurs so gradually that it is impossible to detect any flickering of the lamps.

The Breslau and Charlottenburg central stations, which have heretofore employed a battery for keeping the bus-bar pressure constant, are now contemplating superseding this older method by adopting electro-magnetic regulators.

In closing, I might mention that the patent (D.R.P. No. 150,249, Class 60), as well as the manufacturing rights of this system, belong to the Elektrizitäts-Actien-Gesellschaft, vorm. W. Lahmeyer & Co., Frankfurt a.M., Germany.

THE CALCULATION OF PERCENTAGE ERROR.

By H. G. SOLOMON.

A GREAT deal of misconception prevails in connection with the determination of the percentage errors of an instrument. The whole object of the percentage error is to enable the user of an instrument to ascertain directly from its reading the actual error at this part of its range, and thence the value of the reading. The percentage error then refers to the figures read, and can be used in a simple and logical manner. In many cases, however, the percentage error has not this meaning, but refers to absolute accuracy, when it cannot be used without special interpretation.

Usually the purchaser of an instrument is unacquainted with the method employed in computing the percentage errors, which he is told his instrument does not exceed within certain limits of its range. In deducing from the known value of the percentage error and his instrument reading, the actual error and the true value of the reading, he almost invariably proceeds in one way. He first multiplies the instrument reading by the percentage error divided by 100. The product is the actual error. If his instrument be indicating high, he subtracts the actual error from the original reading, and the difference is the absolute value required. If, on the other hand, his instrument be reading low, he finds the absolute value by adding the actual error to the figures read. The results obtained in this manner are correct when the percentage errors refer to the figures

given by the instrument or to figures directly dependent upon them, but will be quite incorrect if these percentage errors refer to absolute accuracy. For small values of the percentage error the differences in the results are certainly very slight, but they become very large as the percentage errors become high. The point, however, is not the actual difference, small or great, between the two methods of computing the percentage error, but which method should be universally employed so as to avoid ambiguities and mistakes.

Both the value and the meaning of the percentage error depend on the method of its calculation and not in any way on the basis of reference. For instance, it is merely a matter of convenience in arriving at the percentage error of an electricity meter whether the basis of reference be the time, the constant of the meter, the load (watts or amperes according as the instrument is a watt-hour or ampere-hour meter), or the speed, if the meter be of the motor type; the value will depend on the method of computation and, of course, on the load and the state of the meter. It will be at once seen from the above that there exist two methods of calculating the percentage error, the values found from any particular instrument reading and the corresponding reading of the standard used in testing not only being different, but requiring very different methods of application when subsequently the actual error and the absolute value are to be ascertained.

The percentage error is a pure fraction, and the difference between the two methods lies in the meaning assigned to the denominator of this fraction. For the sake of completeness, it may be as well to point out what is meant by a positive percentage error ($+ x$ per cent.) and by a negative percentage error ($- x$ per cent.). A positive percentage error means that the instrument is indicating too much, and, therefore, the correct value is less than that given by the figures read by an amount equal to the actual error of the instrument; in this case the actual error must be deducted from the reading given by the instrument to obtain the true value. A negative percentage error has, of course, just the opposite meaning, and the actual error must then be added to the intrument reading.

Method A.—The percentage error refers to the figures read and can be applied directly.

In this method the percentage error is expressed in the following manner:—

$$p = \pm 100 \cdot \frac{D - D'}{D}, \quad \ldots \quad \ldots \quad (1)$$

where p = percentage error.
D = reading of *instrument under test.*
D' = ,, *standard testing instrument.*

The actual error at any load, *i.e.*, $D - D'$, is obtained at once by multiplying the reading of the instrument D by $\frac{p}{100}$, and the sum or difference of the instrument reading D and this product (the actual error) will give the absolute value D', according as the instrument is indicating low or high. A numerical example will make this quite clear. Suppose that the watts given by an electricity meter are 635, and that at this load the percentage error is — 2 per cent., *i.e.*, the meter is under-registering. The actual error is $635 \times \frac{2}{100} = 12{\cdot}7$ watts, and the true value of the power is $635 + 12{\cdot}7 = 647{\cdot}7$ watts. If, on the other hand, the meter be 2 per cent. fast at this load, the actual error is the same, viz., 12·7 watts, but the true load is $635 - 12{\cdot}7 = 622{\cdot}3$ watts. Formula (1) is the method used by the writer on account of its practical usefulness, as it gives percentage errors which admit of direct application in a simple and easily-understood manner.

Method B.—The percentage error refers to absolute accuracy and cannot be applied directly.

In this case the formula for the percentage error becomes

$$p' = \pm 100 \cdot \frac{D - D'}{D'}. \quad \ldots \quad (2)$$

D and D' have the same meanings as above, the percentage error is now p' and differs from p given by formula (1).

It is at once apparent that the product of $\frac{p'}{100}$ and the instrument reading D will not give the correct actual error. According to this method the percentage error is the percentage ratio of the actual difference between the instrument reading and its absolute value to the absolute value itself, whereas in the former method it is the percentage ratio of this difference to the actual figures read; the numerators of the two fractions are identical, but the denominators are different.

It should be borne in mind that the absolute value D' is only known when the instrument is being checked against a standard, and that the problem is to find this value D' from the known values of the percentage error and D. When the percentage error has been determined according to Method B, the solution of the problem is not so simple as in Method A. To obtain the actual error and the absolute value of the instrument reading, it is necessary to determine a change factor from the percentage error. Further, the change factor varies with the nature of the error, *i.e.*, it is different according as the error is positive or negative.

It can easily be shown from (2) that the actual error, when the instrument is reading high, is given by—

$$D - D' = \frac{p'}{p' + 100} \cdot D, \quad \ldots \quad (3)$$

which, when the instrument is reading low, becomes—

$$D - D' = \frac{p'}{p' - 100} \cdot D. \quad \ldots \quad (4)$$

The change factor is $\frac{p'}{p' + 100}$ or $\frac{p'}{p' - 100}$ according as the instrument is over- or under-registering, and the product of the change factor into the figures read gives in either case the actual error. Suppose that an electricity meter at a certain load has a percentage error of + 4 per cent. (determined by Method B), and that the power supplied to the circuit according to its registration is 315 watts. Since the meter is reading high, the change factor is $\frac{p'}{p' + 100}$ and has the value $\frac{4}{4 + 100}$. The actual error is then $315 \times \frac{4}{4 + 100} = 12{\cdot}1$ watts, and the true value of the power is $315 - 12{\cdot}1 = 302{\cdot}9$ watts. If, on the other hand, the meter be reading low, the change factor is $\frac{p'}{p' - 100}$, and for the same numerical values of the percentage error and the watts, the actual error becomes $315 \times \frac{4}{4 - 100} = 13{\cdot}1$ watts (omitting the negative sign, which merely indicates that the result must be added to the power given by the meter). The true power is, therefore, $315 + 13{\cdot}1 = 328{\cdot}1$ watts.

The change factor can be expressed in a different form from that given by (3) or (4). It follows very readily from (2) that—

$$D' = \frac{100}{100 + p'} \cdot D, \quad \ldots \quad \ldots \quad (5)$$

when the instrument is registering high, and that—

$$D' = \frac{100}{100 - p'} \cdot D. \quad \ldots \quad \ldots \quad (6)$$

when the instrument is registering low. The difference between the two change factors is quite obvious. In the form given by either (5) or (6) the product of the change factor into the instrument reading gives the absolute value, *not* the actual error. The latter can be readily found, and in either case is simply the difference between D and D'.

No possible advantages can be claimed for determining the percentage error according to Method B, as the values obtained by means of it cannot be used directly, but have to be converted in a manner which is not only complicated, but would probably not be employed unless specially explained. Percentage errors having this meaning serve no useful purpose.

It may be of interest to state here that in the Board of Trade Electrical Standards Laboratory the accuracy (or,

more strictly, the inaccuracy) of an electricity meter is not given as a percentage error, but as a multiplying factor.

The Board of Trade formula is—

$$K = \frac{D'}{D} \quad \ldots \quad \ldots \quad \ldots \quad (7)$$

Where K = multiplying factor,

D = reading of *instrument under test*,

D′ = reading of *standard testing instrument*.

For electricity meters D and D′ generally refer to the declared value of the meter constant and the absolute value respectively. The multiplying factor is, therefore, a ratio of the absolute value of an instrument reading to the actual reading. It will be observed that the denominator of this fraction is exactly the same as the denominator in Method A, so that identically the same percentage errors are obtained admitting of direct application in the same manner. The Board of Trade formula is only a different way of expressing formula (1); but it is much more convenient, as it gives a direct connection between the instrument reading and the correct value. Suppose that K = 0·98. This means that the true value of the meter constant is 0·98 of the declared value, taking the case of an electricity meter. In other words, the meter is indicating 2 per cent. high, and the true value of the meter constant is obtained either by taking 0·98 of the declared value, or by taking 2 per cent. and deducting the actual error so obtained from the declared value. Suppose, on the other hand, that K = 1·02. This implies that the true constant (or true power, say) is 1·02 of the declared constant (or meter watts), *i.e.*, that the meter is reading 2 per cent. low.

The value of the multiplying factor not only enables the absolute value of the reading to be determined at once but shows whether the instrument be reading high or low. The Board of Trade system has thus the additional advantage of completely avoiding the use of the signs + and − with the consequent removal of any ambiguity as to their meanings. It will be noticed that throughout this article the numerator of the fraction—percentage error—is always expressed in the same way, namely, D − D′. The numerator, which is the actual error, is the difference between the instrument reading and the absolute value, *i.e.*, **D − D′**, and *not* D′ − D, which gives the same numerical value but is opposite in sign. The definitions already given of a positive and a negative error are quite correct provided the numerator, as in the article, be expressed as D − D′. If, however, the numerator be given as D′ − D, then a negative error means that the instrument is reading high and a positive error that it is reading low—just the reverse to the usually-accepted meanings of positive and negative and, therefore, to be avoided.

MODERN GLOW LAMPS WITH METALLIC FILAMENTS.

During the last few years there has been a procession of new lamps with metallic filaments, of which the end, apparently, is not yet in sight. It is curious to observe how in this, as in so many other respects, electrical science shows a tendency to reversion to primitive types and forms. Perhaps the most striking reversion is to be met with in the case of the turbine, a type of steam engine which ante-dated by many centuries all other known types; but Planté positives for accumulators, knife switches, slotted armature cores, the homopolar dynamo, arc lamps with carbons side by side, and many other examples of reversion can be cited to illustrate the tendency, which is well manifested in the modern imitations of the elementary platinum filament lamps of 30 years ago.

The distinguishing feature of the new lamps is the use of metals of exceedingly high melting points, which, therefore, can be raised to an intense degree of incandescence, without destruction by melting or volatilisation, and in these respects they are superior even to carbon, the efficiencies obtainable, with long life, being even as high as one candle per watt. Tantalum, osmium and tungsten are the metals most generally used, the changes being rung on these; but other and rare metals, such as zirconium, molybdenum and iridium, are also under investigation. One of the latest of these lamps is the "Osram," in which the filament consists of an alloy of osmium with wolfram (*i.e.*, tungsten), as indicated by the title; the chief constituent is tungsten. The German Welsbach Co., which has introduced this lamp, claims for it an efficiency of one hefner candle per watt, or about ·88 British standard candle per watt (1·12 watts per candle). The candle-power is said to be practically constant throughout a period of 1,000 hours, and the life to be still longer. The voltage range, however, as usual, is limited, the lamps being made singly only for voltages up to about 130, and then only for 29 candles and upwards.

Tests recently carried out by the Reichsanstalt, and reported in the *Elektrotechnische Zeitschrift*, on the behaviour of the Osram lamp with alternating current (derived from the public mains, and therefore not strictly constant in pressure) showed that 22-c.p. lamps fell only 6·6 per cent. in candle-power on the average, and lamps of 28 c.p. fell 4 per cent. in 1,000 hours; the candle-power increased slightly for 200 hours, and then fell, passing through its original value at 560 hours. More than half the lamps were in perfect order after 1,000 hours' burning, and it is stated that the lamps behave equally well with A.C. and D.C. The mean consumption of power varied from 1·26 to 1·34 watts per British candle in the case of the smaller lamps, and from 1·25 to 1·30 in the case of the larger ones. Osram lamps have been made of 35 c.p. for 220 volts, and they can be made up to 200 candles; the efficiency is lower in the case of the former, the consumption of power being 1·42 watts per candle.

Particulars of the Osmin lamp were given in a paper read last April before the Vienna Elektrotechnischer Verein by Herr A. Libesny; this lamp, in spite of its name, has really a tungsten filament, and is made by the Osmiumlicht Unternehmung, of Vienna. Lamps of 35 c.p. have been made for 120 volts, and 70 c.p. for 200 volts. The power consumption is about the same as with the Osram, and the light is very well maintained. It is suggested that the economy obtained is due not only to the higher temperature of the filament compared with that of a carbon filament, but also to a property of the metallic filament whereby it is capable of turning a larger proportion of the power supplied into luminous radiation. This raises a question at present in dispute between Mr. Swinburne and the physicists.

It is stated that the Osmin patents (apparently for all countries) have been acquired by the Westinghouse Co., after severe competition with the General Electric Co., of London.

The filament of pure tungsten, in Germany called wolfram, cannot be made by drawing the metal into wire; it has to be produced by roundabout methods, as, for instance, by mixing the finely divided metal with other substances, and then destroying the latter by intense heat, leaving the tungsten in the form of a fine and very brittle thread. The fragility of the filament is one of the principal objections to its use, and, in fact, taken together with the comparatively low specific resistance of the metal as compared with carbon, renders it impossible as yet to construct tungsten filaments of high voltage and moderate candle-power. As with osmium and tantalum, the limiting voltage for 25 or 30 c.p. is in the neighbourhood of 100 volts. The filament is not sensitive to variations of pressure.

Both the tungsten and the Osram lamp must be used preferably in a vertical position, owing to the plastic nature of the filament when incandescent.

With the tantalum and osmium lamps our readers are already familiar; they have been on the market here for a considerable time, and have proved their merit. They, unfortunately, are only made for low voltages (in which we include pressures up to 115 volts), and the former is not suitable for alternating current.

Viewing the matter broadly, it cannot be said that any of these new lamps will exert a material influence upon the progress of electric lighting in this country *in the near future*. Seeing that the vast majority of British electricity supply

systems employ voltages in excess of 200 volts, it is obvious that the field for these lamps is very limited. But for private installations, and in exceptional circumstances, as, for instance, where a transformer can be installed with profit to furnish a suitable pressure, the new lamps are likely to have things all their own way. While the metallic filament lamps are more expensive than carbon lamps, and appear likely to remain so, on the other hand the burnt-out lamps have a definite scrap value, much higher than that of carbon lamps, in which only the platinum counts. The new lamps give a whiter light than the carbon lamps, a feature of value in competition with modern gas lamps. The greater candle-power may prove a distinct advantage; the 16-c.p. lamp so widely used was adopted mainly to replace the batswing burner of about the same nominal value, but the success of the Welsbach mantle of about 40 c.p. shows that a more powerful unit meets with public approval. Moreover, duplex paraffin lamps average about the same value. In many positions a lamp of small candle-power, about 8 c.p., is very useful; but the average 8-c.p. carbon lamp takes about 40 watts, and so does the 32-c.p. metallic filament lamp, so that the only advantage in using an 8-c.p. carbon lamp is the lower initial cost—assuming that the increased candle-power of its rival in such places is of no value. This is precisely equivalent to the relations between the incandescent mantle and the small gas-jet under like conditions.

Whether metallic filaments will eventually be made of small candle-power with good efficiency remains to be seen; he would be a bold man who would declare the feat impossible, or even improbable. In view of the extraordinary results which have been attained in the manufacture of alloys of high specific resistance for use at ordinary temperatures, it is quite possible that similar results may be secured in the case of the more refractory metals, and they may also be accompanied with ductility sufficient to permit of the filaments being drawn in the form of wires, with a great increase in strength, uniformity and cheapness of manufacture. The possibilities open for research are obviously unlimited; an immense amount of work in this direction has already been accomplished, and we regret to say that not an iota of it can be credited to British investigators. Our American friends vie with us in watching with interest the development of new filaments at the hands of German and Austrian scientists; but that is all. The question is of greater moment to our trans-Atlantic cousins than to ourselves, owing to the prevalence of low-voltage supplies in the United States; but this fact is to our detriment at the moment, though we are not prepared to admit that we were wrong in adopting high-voltage supply. The Nernst lamp is not far inferior in efficiency to the new metallic filament lamps, and may yet be greatly improved as experience is gained; and we doubt not that higher voltage will triumph in the end.

In the meantime, there is no occasion for panic. The people most concerned are the carbon lamp makers, and it would but be common sense on their part to take thought for the future. Should metallic filaments come into general use, an enormous expansion of electric lighting would quickly ensue, and those who were best prepared for the change would be the gainers. But such a change could not be sudden; the Osram lamp, which appears to be the most promising of the newcomers, has only just come on the market, and unless great improvements are effected, it will be a matter of years before it materially affects the position. The metallised carbon filament may make a good fight for survival, thought it seems to hang fire at present; and there will always be many people who, regardless of cost, will favour the yellower light of the carbon lamp, just as many still use paraffin lamps, gas, and even candles! But the introduction of a one-watt-per-candle 200-volt lamp of moderate candle-power will be of immense benefit to the electrical industries, and we shall cordially welcome it when it comes.

The *Times Engineering Supplement* recently censured the technical Press for neglecting to make a sensation of the revolution in lamp-making. When the revolution begins to take shape, we shall not fail to call attention to the fact. It is a highly desirable kind of revolution; but the time is not yet, and we cannot expedite its progress by hysterics.

RAIL CORRUGATION.

At any time the information contained in the replies from Continental tramway managers to questions asked by the Committees of the International Union of Tramways and Light Railways would be highly interesting, and at this time they are particularly so because one series is devoted to rail corrugation.

It is not an easy matter, if, indeed, it is possible, to make a correct analysis of the replies, but this is what can be gathered from an approximate investigation:—

Out of 85 tramways returning, 30 have corrugations more than slightly, 24 have them slightly, while 31 have them not at all. The suppositions as to the causes of the waves are numerous, but not original. Ten put them down to a condition of the metal due to the process of rolling, or to non-homogeneous steel. One thinks the steel too soft; one suggests a choice between elastic seating, badly fixed rails, bad joints or defects in the metal; one puts the blame on hard tires; at least three think loose rails have something to do with it; weakness of the head or web, says one for some obscure reason; high speed, says another, with more probability on his side; bad drainage of the foundations is selected by two; and without troubling about the numbers who notice the phenomenon at curves, and put it down to the wheels slipping, we may mention two who hope to cure that trouble by super-elevating the outer rail in the way which is easy enough on a railway but is not yet feasible in a street. Is there any reason why our surveyors should not help us in this matter?

Then two contributors favour irregular cold rolling by the car-wheels; one thinks that side rolling of cars on straight track may produce waves, one distinctly holds the Panton theory of a single ended drive doing the mischief, while two more attribute it to "the system of driving by gears." Whether that means particularly the single-gear arrangement, or that any gearing would do it, is not clear. One bold, bad man accuses "electric traction"; three consider braking sufficient; two suggest the differing oscillations of the rails and cars, and, lastly, three, including Glasgow and Lyons, have been driven to conclude that the concrete bed is too rigid for the rail, and the places named are trying the effect of padding with wood or lead between the base of the rail and the bed.

That statement shows clearly how little is known about the matter, and how much is wanted a systematic inquiry of a higher order than the limited questions and answers before us.

The Grosse Berliner Tramways say emphatically that the corrugations have nothing to do with electric traction *per se*, for the Berlin Stadtbahn and other large steam railways are troubled in the same way.

The Breslau Tramways find the waves as much on the straight as on curves, and on rails which have been supplied at various times, while, on the other hand, one of the Parisian companies find their corrugations on rails of one date, and attribute them to bad metal.

The puzzling nature of the riddle is indicated by the Brussels Tramway Co., who say "they come where the service is very heavy, yet in other places where the service is just as heavy, they do not arise, and, moreover, they appear on sections where there are not more than 8 or 10 cars an hour."

In Cologne they are coming out mostly on straight line, but only where the track is paved in a particular way, and they are on firm as well as on loose rails. Nuremberg-Furth, too, says that the fault is present equally on rails which have an elastic bed as on those which are fixed rigidly. Glasgow ought to inquire into that before it goes in for sleepers very largely. Only from Hamburg comes good news. There the corrugations are disappearing.

The experience on the St. Gall Tramways is worth noting. First the waves came on curves, on sections with bad drainage, and where speeds were high, but now they are visible on all parts of the track, even where the speed is only 8 to 11 m.p.h.

At Wurtzburg the corrugations occur chiefly on curves on rising gradients.

Perhaps the speeches at the Congress will help to boil down the unwieldy number of theories which now flourish, to something more easily handled. At present we must confess to feeling overpowered by the conflicting multitude.

Notwithstanding this wide-spread and growing disease, the Continental tramways are sanguine about the life of their rails, for in another return a good many of the figures are much what we are beginning to question in England; that is to say, many of them err too probably on the high side.

The table below shows how very different the estimates are.

Life of Rails in Years.

Number of replies.	Straight line		Curves.
	Heavy service.	Light service.	
15	5 to 10	—	—
5	6 to 12	—	—
4	12 to 15	—	—
4	10 to 25	—	—
1	34 (Brussels)	—	—
1	—	8 to 10	—
20	—	10 to 20	—
1	—	25	—
1	—	15 to 30	—
7	—	—	½ to 5
17	—	—	1 to 10
4	—	—	5 to 15
1	—	—	7 to 20

Is it possible that discrepancies so great can exist? We at least do not dare to take upon ourselves the responsibility of denying, and if we do not, we are faced with the necessity of acknowledging that the estimates which figure so largely in the promotion and re-sale of tramway property are of little or no true value, for invariably they are based upon the previous experience of the experts who make them, whereas it would seem that every tramway is more of a law unto itself than most people have been inclined to admit.

There is a letter in the September *Street Railway Journal* which reviews briefly a few of the theories mentioned in this journal some weeks ago, and, wisely enough, urges caution on those people who have flown to some special theory and try to clothe it with evidence, to the exclusion of all others. The writer says, for instance, that the return current theory is based on false premises, as ordinary segregation does not occur in that part of the ingot which becomes the head of the rail, but in the web.

At this stage of the discussion of such an obscure subject, the use of rigidly positive terms should be avoided, and much as we respect the opinion of a writer in the *Tramway and Railway World* for September, his conclusion savours too much of the infallible to be palatable—"In all cases the true solution will undoubtedly be found in greater flexibility of the running gear and more elastic road beds, or less uniform rolling stock."

A little doubt is a wholesome thing.

Watertight Signalling Key.—A new pattern of watertight signalling key for mining purposes has been brought out by the Sterling Telephone and Electric Co., of 200, Upper Thames Street, E.C. This device, which is illustrated and described in Pamphlet No. 121, of mining, engine house and ship telephones, is of very substantial construction, with a heavy cast-iron case. The lever, which can be operated by hand or by a pull-cord or chain, is carried on strong bearings, and actuates the contacts (which are of the Morse type, and therefore provide, if desired, for both call and reply signalling) through a metal diaphragm, which ensures perfect water and gas tightness. The conductors are brought into the interior through a stuffing-box provided with a screwed gland and rubber packing. A strong spring returns the lever to its normal position, and rubbing contacts are employed. It would be difficult to provide a design better adapted to withstand rough usage and adverse conditions.

A NEW METHOD OF EMPLOYING TWIN LEAD-COVERED WIRE FOR ELECTRIC LIGHT WIRING.

A paper was read on the above subject on Tuesday, the 25th ult., by Mr. E. L. Berry, before the London Section of the Electrical Contractors' Association.

The object of the author is to devise some method of cheapening the cost of electrical installations, and his opinion is that this can be done by the use of twin lead-covered wire. There has been a good deal of correspondence in our columns on the use of this system, and its advantages were explained in an article in our issue of April 20th last, p. 625.

In his paper Mr. Berry points out the disadvantages of the present methods, namely, wood casing and tubing methods, the disadvantages being already well known. One of the chief difficulties hitherto in the use of twin-lead wire has been the want of a satisfactory method of jointing, and probably had a satisfactory jointing box been in existence the twin-lead wire system would have made much more progress than it has done. It is in this direction, therefore, that Mr. Berry's firm have been working, and they have devised a joint-box, shown in the accompanying illustration, which consists essentially of a porcelain base having contact plates, and wire ways moulded in the porcelain in which the wires are laid. Mr. Berry is of opinion that the troubles which have in the past been experienced due to pitting and corrosion of the lead have been due largely to a want of continuity and efficient earthing of the lead covering. He makes provision for this in his joint-box by means of a brass plate with clamping saddles fixed in a rebate in the sides of the joint-box. The lead covering is clamped down to the earthing plate, so that all wires entering the box are efficiently bonded together, and they are then earthed by means of a brass clamp connected to a water pipe.

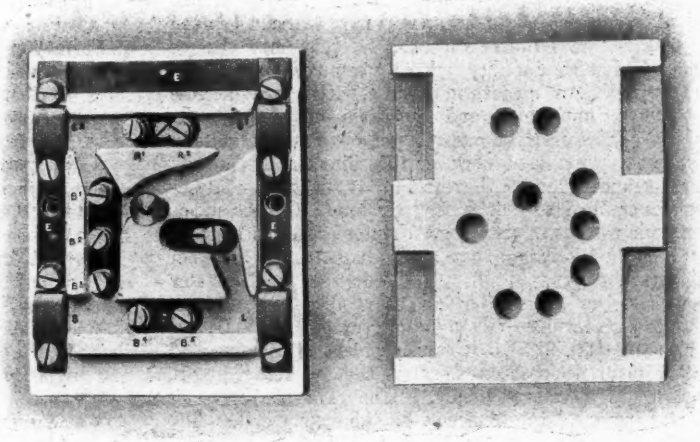


Fig. 1.

Connections.

Circuit wires enter at C^1	Red	wire connects to terminal B^2
	Black	" " " B^2
Circuit wires enter at C^2	Red	" " " B^1
	Black	" " " B^1
Switch wires enter at S	Red	" " " B^4
	Black	" " " B^3
Light wires enter at L	Red	" " " B^3
	Black	" " " B^5

In the case of a wall socket not controlled by a switch,

Wall socket wires enter at L	Red	wire connects to terminal B^3
	Black	" " " B^5

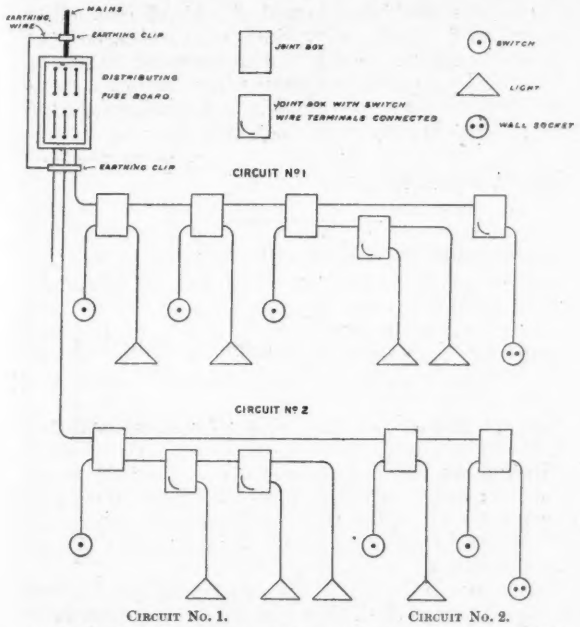
And the terminals B^3 and B^4 are connected by bare copper wire.

This is the essential feature of the method proposed by Mr. Berry, other features of his proposal deal with the method of protecting the lead-covered wires where laid under plaster.

For sunk work it is proposed to cut a chase in the wall deep enough to take the wire, which is then laid in the chase and covered with hoop steel 2 in. wide, secured by clout nails driven into the joints of the brickwork. Where passing

through brickwork it is proposed to draw the wires through bitumen tubing. As a precaution against damp in sunk work it is proposed to insert a layer of water-proof paper or tape or something of a like nature between the hoop steel and the lead wire.

Mr. Berry considers there would be a considerable saving in the cost of erection of installations carried out on this method over existing methods, and that there would be a considerable reduction in the amount of stock. In his reply to the discussion which followed the reading of the paper, he said that with piping systems his firm found it necessary to keep in stock upwards of 120 different patterns of fittings, and from an analysis of various installations, he found that the cost of fittings as compared with the actual cost of close



Circuit No. 1.	Circuit No. 2.
2 points controlled by separate switches	3 points controlled by one switch
2 " " one switch	1 " "
1 wall socket point not controlled by switch	1 wall socket " controlled by one switch

N.B.—In the diagram the joint-boxes are shown vertically and with the end, having no earth plate, at the bottom; this is the same position as in the detailed illustration of the joint-box, fig. 1.

Fig. 2.

joint conduit ranged from 100 to considerably over 200 per cent., the average being about 150 to 160 per cent. of the cost of the piping.

In the discussion which followed, Messrs. W. R. Rawlings, Frank Broadbent, Leonard Tate, Elgar (Newport), Charles Rawlings, Frank Suter and Josephs took part, many of the speakers referring to troubles which they had encountered in their experience with lead wire due to corrosion. Some were of opinion that the joint-box shown by Mr. Berry ought to have been watertight. Another point raised was that there would be considerable surface leakage and electrolytic action between the lead and brass covering.

Mr. Berry, in his reply, gave details of some insulation tests he had carried out on some of the boxes when subjected to the action of steam. The insulation across the terminals in one case was found to be 250,000 ohms, and in another case where the joints had been painted over with P. & B. water-proof paint, the insulation resistance under the same conditions was under 10 megohms. He undertook to give at a later date details of actual costs of some installations he was now putting up on this system, so that members might compare this with the cost of work on casing and piping methods.

Accumulators for Canada.—The British Empire Motor Trades Alliance, Ltd., has received an inquiry from a large Canadian firm who are desirous of purchasing the Canadian rights of a really good electric accumulator. British manufacturers are requested to apply to Mr. J. B. King, secretary, 11, Red Lion Square, W.C.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Cost of Suction Gas Power.

The article on "Suction Gas Power" in your issue of September 21st, is a distinct libel on this excellent little plant, and the remarks of your correspondent are calculated to inspire dread in the uninitiated; in fact, it would appear more dangerous to work a suction plant than to work in a powder factory.

Now, what I have seen of these plants is quite the reverse. They seem very simple and safe, and are looked after by unskilled workmen; no one has been poisoned or blown to pieces, in spite of the unskilled workmen. Therefore the unskilled operator for a suction plant is *not* a myth.

Again, your correspondent would make it appear that any navvy would be sent to work one without being instructed in the work. This, of course, is utter nonsense, the operator being usually instructed for a week or two (according to his capacity for taking things in), or until he is able to manage by himself, even to starting the engine and advancing the ignition. This latter operation, I assure your correspondent, is quite simple.

Another statement is very much enlarged upon, viz., the escape of poisonous gases. This, of course, would be possible if the plant were enclosed in a place void of air or ventilation. Now, as a rule, these plants are placed in the open air, with a cover over them, or, if in a brick place, at least one side is open and plenty of ventilation, so there is not much danger from carbon monoxide gas.

The other points I will leave to the makers of the plant, whom I think you will hear from.

T. Hagues.

Rotherham, *September 24th*, 1906.

[We regret to say that death by CO poisoning *has* occurred in connection with suction gas plant, and that explosions have also been recorded.—Eds. E.R.]

Mains and Distribution Supervisor—H.M. Dockyard, Malta.

I write this letter for the information of readers who have not had the misfortune to be put on an Admiralty short list. Early in July I applied for the above post. On September 22nd I was informed that I was one of the selected candidates. It was desired that I should attend at Portsmouth during the next week for a personal interview, subject to the following conditions:—

(a) I must first take train to Greenock, there to be medically examined by the Naval "Surgeon and Agent."

(c) If pronounced medically fit, it is desired that I should travel to Portsmouth for an interview.

(d) No travelling expenses, &c., whatever will be borne by the Admiralty.

I happen to reside in a Glasgow suburb, and it will be noted that I have to travel to Greenock and back, then to Portsmouth and back, spending £4 or £5, and wasting two or three days on the off-chance of being appointed to a post in Malta worth the magnificent salary of £200 a year, plus the fever and ague of that delightful island.

If I did not happen to obtain the appointment I should have wasted a few days and spent, say, £5 for the pleasure of a personal interview with some very mean individual at Portsmouth. The terms of the advertisement stated to the effect that only "thoroughly good men need apply." I do not say I am a "thoroughly good man," but I flatter myself that I am too good to be humbugged about in the manner suggested by these Admiralty officials, nor do I happen to be starving, or I should probably borrow £5 and toss up whether I should go to Portsmouth, or "back a horse."

Any corporation, any firm of repute, and any decent individual pays expenses to selected candidates, and the meanness of the Admiralty on such an occasion is not only a disgrace to *them*, but would be a disgrace to a firm of Polish Jews.

Mr. Wordingham, if I remember rightly, always paid such expenses during the time he served the Corporation of Manchester, and this kind of thing should make him proud of the Admiralty, who are not so dignified as the Manchester

Corporation, or any rural district council, as such bodies would not lower themselves to haggle with selected candidates over travelling expenses!

I have declined the very generous offer of the Admiralty, because if they are so mean with a candidate *before* they have booked him for five years, what is going to happen to this candidate *after* he has been caught? Is it a fact that station and main supervisors are not allowed annual leave unless their pay is stopped, or does this only apply to the poor station supervisors? Here again I understand that Mr. Wordingham's shift engineers (when he was at Manchester) got three weeks' holiday on full pay, and their pay was £3, not £2 per week.

I would suggest to Mr. Wordingham that before the Admiralty can get "thoroughly good men" they will have to—

1. Pay the market value for such men.
2. Pay the expenses of their short lists.
3. Give an annual increase in the case of a five years' agreement.

Because *thoroughly good men* are not, as a rule, starving, and can generally live comfortably and in an *independent position* in spite of the fierce competition of to-day.

Old Trout.

[While sympathising with our correspondent, we feel sure that Mr. Wordingham is not responsible in any way either for the conditions attached to the interview or for the salary offered. As Mr. Wordingham's official position probably precludes him from replying personally, it is hardly fair to bring his name into the matter.—EDS. E.R.]

Efficiency of Electricity Generating Stations.

With reference to the article by Mr. C. J. Evans on "Method of Comparing the Efficiency of Electricity Generating Stations," whilst admitting that I consider he is correct in his statement that the present coal costs are of little or no value for comparison, I certainly do not agree with him in his method of comparison by British thermal units per Board of Trade unit. Thermal efficiency is only one of the many factors in the cost of coal. There is the buying efficiency, and the adaptability efficiency, as we know that a coal suitable for one class of boiler is not suitable for another, and so on; there is also station efficiency, plant load factor, and many other points which come into consideration as a comparison.

I would suggest that any improvement in the way of making comparisons of tables would be to separate the carriage and cartage from cost of coal, *i.e.*, the cost of coal would be the pit-head price plus brokers' commission, so that every station would be on an equal footing, and the difference in coal costs would represent the combination of commercial and engineering ability.

J. Horace Bowden,
Borough Electrical Engineer and Manager.

Poplar Electricity Works,
September 29th, 1906.

Trolley Wire Maintenance.

With reference to the article appearing in your issue of June 22nd on "Trolley Wire Maintenance," by Mr. P. S. Sheardown, M.I.E.E., of the Dublin United Tramways Co., I consider the method adopted for overcoming the difficulty of the crystallisation and breakage of the trolley wire at ears and other points of suspension, is not by any means the best method of overcoming the difficulty. I think it is advisable to put these anchors or "preventers," as they are frequently termed, at section insulators and joint-ears at the time of erection of the wire, but the fatigue at the ears, especially with mechanical clips, is, I consider, not nearly sufficient to warrant the erection of these anchors at the end of two years' service. From the diagram given, it would appear that soldered ears are used, and it is probable that this is the cause of so much trouble being experienced with the breaking of the wire.

Would it not be better, at the end of two years, to move the trolley wire so that the clip is attached to a place several feet from the old point of suspension, thus ensuring a new cross-section, where the fatiguing action can start afresh? I think a lot of the trouble which is experienced at the clips is due to the trolley wire not being sufficiently strained up, thus allowing the trolley wheel to strike the clip with much greater force than would be the case with a well-strained trolley wire. My suggestion to move the trolley wire several feet longitudinally would entail a considerable amount of labour if soldered ears are used, and I think this is a very strong reason why mechanical ears should be adopted.

Mr. Sheardown states that they have 38 miles of double track anchored in this way in Dublin. The sight of three clips at every point of suspension is certainly not æsthetic, and I should think that it would be more economical in the long run to scrap the old wire and erect new wire in its place, and use mechanical instead of soldered ears. The scrap value of the old trolley wire is considerable, and the delay and annoyance caused by a broken trolley wire, even if held up by anchors, is a factor worth taking into consideration when the smooth running of the system is one of the most important points to be kept in view.

Robt. D. Dixon.

Sydney, *August 25th*, 1906.

Manufacturers Selling Direct to Consumers.

Seeing a number of letters in the REVIEW of late *re* the above, I would like to give a sample of the treatment served out here lately by a manufacturing firm to a wiring contractor, who accompanied his client to their showroom to choose fittings for a villa, and spent some considerable time in selecting and advising on same.

Calling next day with list (heights of ceilings, number of switches on each fitting, fixtures, &c.), he politely asked if, in giving prices, they had reserved anything for the wiring contractor; they simply laughed, and said they did not give any commission to any contractors unless they assured them of all their orders, and they denied that they gave discounts to consumers or architects.

This is not the first time this manufacturing firm has done the same thing, and the Contractors' Association are not doing their duty as expected of them, or they might have more members.

D. M. G.

Glasgow.

As the engineer of a small electric supply works, the writer has taken great trouble to induce consumers to use good lamps. The advantage taken of the ignorance of consumers in country towns is very discouraging. Would one of the leading incandescent lamp manufacturers please explain what policy should be adopted when letters like the following from firms representing themselves as "incandescent lamp manufacturers," with an English name and address, are sent to one of our consumers who owns a draper's shop:—

September, 1906.

Dear Sirs,—In the hope that you may be able to increase business with our lamp, we beg to say that in future we shall be pleased to supply you at reduced prices, viz.:—

High voltage, 8 and 16 c.p.	...	...	6½d. each
Low " " "	...	...	5½d. "

Every lamp is guaranteed, and there is no other make whatever that is manufactured of better quality, so that we are confident of your clients receiving full satisfaction.

We assure you of every best attention, and trust that you will kindly favour us with your esteemed orders.

Yours faithfully,
Per ———.

Fair Play.

Referring to our letter to you of the 14th inst., and previous correspondence, this was sent to you without our knowledge by a member of our staff who was not authorised to do so.

We regret that the A.E.G. English Manufacturing Co., of 4-5, New Compton Street, London, W.C., was confused with the A.E.G. (Allgemeine Elektricitäts Gesellschaft), and the Electrical Co., of 121-5, Charing Cross Road,

London, W.C., and we feel that our sincere apologies are due to the last two named firms for the introduction of their names into this correspondence, as neither of them had anything to do with the transactions mentioned.

The Northern Electrical Co.
PERCY WATSON.

Grimsby, *September 26th*, 1906.

Chloride Accumulators.

Referring to the criticism in your issue of the 21st inst., on Sir David Salomon's book "The Management of Accumulators," it appears to be thought by many that the object of our wood diaphragm separator is solely a mechanical one for preventing internal short circuits, and, therefore, possesses no novelty. This is erroneous, and whilst it undoubtedly does fulfil this function, it has the additional value, acquired by a special treatment, of maintaining the capacity of the cell, over a period of years, in a manner which is not possible by the ordinary method of separation. In order to obtain this benefit, it is absolutely essential that the wood should be specially treated, and the failures in the past with wood as a separator have been due to the fact that the injurious substances have not been removed from the wood before insertion in the cell.

The Chloride Electrical Storage Co., Ltd.,
FRANK CRAWTER, *Manager, Sales Department.*

London, S.W., *September 25th*, 1906.

The Imaginary Motor-'Bus.

I have just been reading a leaderette under the above title in your current issue. I am evidently not intended to take it very seriously, for, apart from various loose and extravagant phrases, you imply that I have said things that I have not said.

It might, however, be well for your readers to know that the title of my contribution to the *Outlook* was somewhat different, *i.e.*, "For and Against the Motor-'Bus." That being so, the following remark seems a little out of place :—"We cannot say that Mr. Bright puts his case in the most sanguine light, and he would have done better to have left the matter after reproducing the old story about the flexibility of the motor."

If you or your representative for the moment happen to be very much interested in the cause of electric tramways, there is no reason why you should assume that those who do not happen to share all your views are necessarily concerned with the interests of the motor-'bus. The fact is, I am not associated with any system of locomotion, and any views that I may have ventured to express "For *and Against* the Motor-'Bus"—or for and against electric tramways—have, at any rate, the merit of being entirely disinterested. I hold no brief for anyone, consequently I have no "case ;" and the main tenour of my remarks was that motor-'buses and tramways have their separate and distinct spheres, the one being better suited for one set of conditions and the other for another. But I still think that the motor-'bus is more open to improvement than the tramway.

Charles Bright.

Westminster, *September 25th*, 1906.

The Penetrating Properties of the Mercury Arc Light.

I have read the letter from "Sol" appearing in your issue of the 14th inst., and find that he, like Mr. Marinier, entirely misses the principal point in my argument, which was clearly expressed in my first letter on the subject in your issue of August 3rd, and for "Sol's" benefit I will repeat the view therein expressed that "if two sources of different coloured illuminants have the same flux of light per square centimetre of radiating surface, then the illuminant rich in blue light will penetrate the atmosphere somewhat better than the illuminant rich in red and yellow light."

It is an elementary fact, that water seen by transmission through a great thickness has a greenish tint, and I think that nobody will dispute the further fact that of all colours contained in white light, water will allow green to pass most easily ; and if we substitute air for water in the above statement, then it appears reasonable to conclude that air allows blue light to pass most easily, and I find corroborative opinions as to this in all the principal scientific works on the subject which deal with the colour of transparent bodies."

"Sol" propounds a theory which I have heard of before, but which I do not think will bear examination, because his theory requires the admission that the atmosphere is filled with uniformly distributed particles of solid matter of uniform size, namely, of a size so small that they would only be capable of reflecting the short waves of blue light, and there is no justification whatever for such an assumption.

The popular but entirely erroneous idea that red light is more penetrative than blue has gained ground simply as a result of careless observation.

Two identically similar oil lamps are taken, and a red glass is put in front of one of them, and a blue glass in front of the other, and the man in the street says that the red light is much the brightest, but he entirely forgets or does not appreciate the fact that there is much more red light than blue light in the spectrum of these oil lamps, and therefore the *quantity* of red light filtered through by the red glass is naturally greater than the *quantity* of blue light filtered through by the blue glass.

I repeat, however, that in my opinion the question of penetration is more influenced by light density than by colour.

C. Orme Bastian.

London, N.W., *September 25th*, 1906.

MANCHESTER ELECTRICITY UNDERTAKING.

REPORT BY MR. S. L. PEARCE.

A REPORT by Mr. S. L. Pearce, the chief engineer, on the capacity of the existing electricity works of the Manchester Corporation and the need for further extensions has been issued. It has been considered and approved by the Electricity Committee, whose recommendations await the decision of the City Council.

Mr. Pearce gives the average generation costs of the three stations in Dickinson Street, Bloom Street, and Stuart Street in the following table :—

	Dickinson Street.		Bloom Street.		Stuart Street.		All stations.	
	Total.	Average per unit generated.	Total.	Average per unit generated.	Total.	Average per unit generated.	Total.	Average per unit generated.
Coal, &c.	£9,389	·24d.	£9,231	·17d.	£21,255	·16d.	£39,875	·17d.
Oil, waste, water and engine room stores..	1,716	·04d.	1,249	·02d.	3,590	·03d.	6,555	·03d.
Wages and salaries—Generation	5,356	·13d.	3,994	·07d.	6,157	·04d.	15,507	·07d.
Repairs and maintenance of buildings, plant, &c., at generating stations ..	4,092	·10d.	2,737	·05d.	6,066	·04d.	12,895	·06d.
Total generation costs, exclusive of special renewals	£20,553	·51d.	£17,211	·31d.	£37,068	·27d.	£74,832	·33d.
Units generated ..	9,610,941		13,159,215		32,255,810		55,025,966	
Load factor	19·31 %		20·38 %		38·44 %		27·75 %	

The figures bring out very strikingly the inefficiency of the Dickinson Street Works, as compared with the other two stations. The reasons, Mr. Pearce says, it is hardly necessary to consider at the present stage. The practical question is how best to utilise the more economical conditions obtaining at Stuart Street and Bloom Street, and what expenditure the department would be put to in carrying out a scheme, including the shutting down of the Dickinson Street station for six months in the year. The conditions existing at Stuart Street are "about as good as can be expected"; at Bloom Street half the plant is in operation, one quarter being stand-by, and the other quarter down for overhaul. Dickinson Street takes up the balance of the load as and when required, and is also largely utilised as a stand-by station to be brought into operation for dealing with storm loads and dark weather in the summer months. The problem is, therefore (1) to do without the assistance of Dickinson Street during the summer months ; and, (2) at the same time, keep the necessary amount of stand-by and load plant at the City stations requisite for dealing

with any circumstances that may arise; and further (3) to justify this course by the financial saving effected.

The solution of the problem is to be found in the fact that the stand-by charges can be better borne by the Stuart Street station, as the whole matter turns chiefly on the coal question, for the following reasons:—The steam generating plant at Stuart Street is more economical than at Dickinson Street; (2) less boiler capacity would be required at Stuart Street for the same stand-by loads; (3) the normal load at Stuart Street is higher than at Dickinson Street, consequently more plant is in commission, and the former station is in a better condition to meet the sudden demands; and (4) the normal maximum load at Stuart Street being about 6,000 KW. during the summer months, as against the 2,000 KW. at Dickinson Street, the amount of stand-by boiler plant in proportion would be less at Stuart Street than at Dickinson Street. Careful tests have shown the amount of coal burnt per day of 24 hours at Stuart Street, by the large boilers, in keeping up to pressure on the range to be 15 cwt. per boiler. On this basis, and taking the actual working costs for the summer of 1905, Mr. Pearce proceeds to show in detail what would be saved by the shutting down of Dickinson Street for the six months.

The average costs for the above period were:—

Dickinson Street	·55d.	per unit generated
Bloom Street	·35d.	„ „
Stuart Street	·288d.	„ „

To the Stuart Street figure must be added a percentage representing units lost in transmission from Stuart Street to Dickinson Street, and conversion at Dickinson Street from high tension three-phase alternating to low tension direct current. This is ascertained to be 17 per cent. The corrected figure would, therefore, be ·347d. per unit generated.

For the six summer months of 1905, the units generated at the respective stations were:—

Dickinson Street	4,072,811
Bloom Street	5,217,972
Stuart Street	14,242,043

On this output, and with the figures for works' costs as given above, a gross saving of £3,445 could be realised by meeting the Dickinson Street load elsewhere. This is a moderate estimate of the saving that might be expected under this heading, because of the very much lower working costs obtaining now at Stuart Street than in the summer of 1905. The average for the three months of the present year at Stuart Street is ·243d. per unit generated, and for June, the third month of the three, ·222d. per unit generated. On the other hand, at Dickinson Street—and this is a point the engineer wishes to emphasise—the present costs cannot be much improved upon, if at all, with the existing steam generating plant, and having in view the extremely poor conditions as regards load-factor. Suppose, for example, the Stuart Street figure be taken at ·25d.—a fair figure—the saving expected for the summer of 1907 would be, for the same output, £4,225.

"Reference," Mr. Pearce goes on to say, "has been made to the cost of transferring the stand-by changes to Stuart Stuart, or, in short, of maintaining the stand-by boiler plant at that station. I shall deal later on with what this must actually amount to, but for the present it may be taken to mean three extra large boilers. Calculations show this to work out to 2¼ tons per day, equivalent over the six months to an increase of ·0054d. on the fuel costs of that station. This represents a figure of 1½ per cent. on the works' cost. Taking other points into consideration, such as the wear and tear, and increased maintenance on the stand-by boilers, and the slight addition to the running staff that may be necessary, I have estimated on a total increase to the works' cost at Stuart Street of 2½ per cent., due to the transference to that station of the 'stand-by' required for the city stations. The figure, therefore, of £4,225 given above, needs correcting to the extent of £142; the saving, therefore, due to the shutting down of Dickinson Street may be put at £4,083. It is a moot point whether the apparent increase that may be expected on the Stuart Street costs will not be entirely swamped by the gain of the new and exclusively day load that will shortly be given to the station."

Turning to the wages question, Mr. Pearce says there would be a saving on this account, during the winter, as well as in the summer months.

Next came the expenditure side of the account. "The maximum combined traction, lighting and power load hitherto reached on the city stations for a stormy day in last summer was 9,860 KW. Taking into account this normal annual increase, it is not too much to say that for the summer of 1907 a total of 11,000 KW. may be reached under similar conditions and which the Dickinson Street and Bloom Street stations must be prepared to meet. Assuming Dickinson Street shut down, the plant available to meet this demand is as follows:—Bloom Street, three steam sets 5,400 KW., Dickinson Street, four sub-station converter sets 2,000 KW.—balance required 3,600 KW. Allowing for a margin of spare plant, three new sub-station sets of 1,500 KW. capacity each, or a total of 4,500 KW. would be required, together with the necessary high and low tension switch-gear, and their complement of high tension three-phase mains from Stuart Street." In any case, additional high tension three-phase plant will be needed at Dickinson Street next year. The following estimate of the cost of carrying out the proposals now submitted is given:—

4,500 KW. of sub-station plant erected	£12,000
H.T. and L.T. switch-gear and gallery (Dickinson Street).. ..	2,500
42,400 yards of duct work for H.T. mains	7,500
Two ·25 sq. in. H.T. mains	8,000
Contingencies, 5 per cent. on £14,500, say	750
	£30,750

And there will be an additional annual charged on revenue of about £1,999, although it should be noted that a large proportion of the item of £7,500 for mains duct work is not strictly incidental to the scheme.

The installation of further sub-station plant at Dickinson Street will entail the removal of Nos. 9 and 10 Goodfellow sets, costing originally £5,524, towards the liquidation of which a sum of £1,368 has been set aside from the sinking fund, leaving £4,156 to be accounted for out of revenue.

The position is thus summarised:—On the one hand, there is an estimated annual gross saving of £4,083, and, on the other hand, an additional yearly charge for interest and sinking fund of £1,999, leaving a net annual saving of, approximately, £2,084 if the proposals set forth are adopted.

There is a supplementary report by Mr. Pearce, dealing with the plant capacity at Stuart Street. The present installation has a capacity of 16,500 KW., of which one large unit of a capacity of 3,750 KW. forms a reserve, leaving a margin of working plant of 12,750 KW. The maximum load at Christmas, 1904, was 7,200 KW.; 1905, 9,400 KW.; and it is estimated that the two next winters will see the load reaching to the following figures:—Christmas, 1906, 11,000 KW.; 1907, 12,500 KW. For reason stated, Mr. Pearce considers it desirable to extend with a unit of 5,000 KW. capacity. No addition would be needed to the existing boiler plant. As to the type of unit, he strongly recommends a turbo-generator. The delivery and erection of this could not be completed under 18 months. This time would be little enough, and it is the main reason why a report is brought forward at this juncture bearing on an extension at Stuart Street.

The Electricity Committee, having considered this report, has authorised Mr. Pearce to prepare plans, &c.

An estimate is given of the cost of the Dickinson Street and Stuart Street extension schemes.

Dickinson Street scheme:—£30,000.	
Stuart Street scheme:—	
One 5,000-KW. turbo-alternator erected	£21,000
High tension switchgear	2,500
Pipe work	500
	£24,000
Contingencies (for both stations), meters and motors	25,656
Total	£79,656

The item for motors and meters is to provide for future needs arising from the exhaustion of existing borrowing powers.

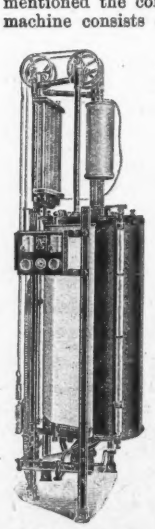
Deducting from the above total of £79,656, mains work (£15,500) for which borrowing powers already exist; and balance of loan outstanding on plant displaced (£4,156), there will be left a net sum of £60,000. To provide this the Council is recommended to make application to the L.G.B. for the necessary borrowing powers.

THE ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

(*Continued from page* 486.)

Leonard Shaw.

Among the several electric copying machines on view must be mentioned the continuous rotary copier shown by this firm. This machine consists chiefly of a vertical semi-cylindrical sheet of glass, over which the tracings slide, and an arc lamp, which is made to travel up and down the axis of the cylinder. As will be gathered from the illustration, the sheet of glass is supported by a light metal framework, and its cylindrical form completed by a sheet-iron guard. At each of the vertical edges of the glass a small roller is fixed. An endless band of canvas, of a width equal to the height of the glass, passes from one roller round the back of the glass to the other roller, and thence back to the first. The two folds of canvas are kept clear and at a proper tension by two idle rollers at the back. The tracings, with the printing paper behind them, are slipped in between the canvas and glass on the right of the machine, and, being dragged round by the canvas, are delivered from the opposite side with the exposure completed. An arrangement of speed cones is used to regulate the rate at which the canvas travels. Two light rollers are fixed to the front of the machine to wind long tracings from and on, as they emerge again.



Continuous Rotary Photo-Printing Machine.

From the above description it will be seen that, apart from the width of the tracing, the capacity of the machine is unlimited. Prints of great length, such as those used for railway work or in shipyards, can be taken by it as easily as smaller ones, and only require a proportionately longer time.

Ferro-prussiate (blue) prints can be passed through at the rate of 1½ lineal feet per minute. Ferro-gallic (black) prints take about

twice as long. A machine for copying tracings 40 in. wide occupies a floor space about 2 ft. 3 in. square, is about 8 ft. high, and uses about two B. of T. units per hour. It will turn out about 2,000 sq. ft. of blue prints in eight hours, and the lamp will run at least a day without attention.

This type of machine is made in various sizes up to 54 in. wide.

Excelsior Engineering Co., Ltd.

"Excelsior" pumps are the special attraction of this company's stand, six high-speed pumps fitted with Gutermuth patent valves being on view. The various types include single, double and treble-barrelled vertical and horizontal patterns, arranged for speeds of 225

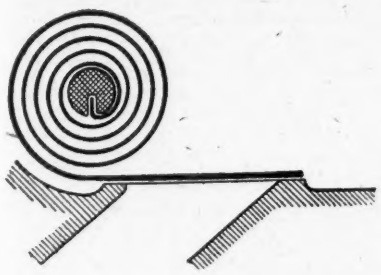


Fig. 1.—Diagram of Gutermuth Valve.

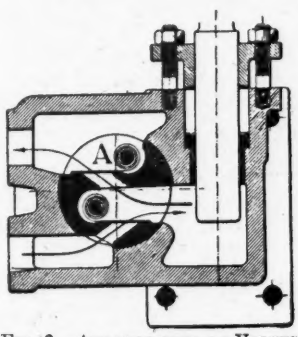


Fig. 2.—Arrangement of Valves, "Excelsior" Pump.

to 350 r.p.m. The main feature of the exhibit is, of course, the high-speed working made possible by the use of the Gutermuth valve, which incidentally enables these pumps to be efficiently driven by electric motors.

The Gutermuth valve was referred to at some length in the Electrical Review, July 29th, 1904, but in view of the interest attaching to this ingenious device, and of its probable wide adoption in the near future, some further details appear desirable. The valve consists of a strip of phosphor bronze sheet (fig. 1), one end of which is coiled upon a spindle to form a spiral, leaving a part of the sheet (which is also thicker than the coil) flat, to form the valve flap proper.

As seen, the centre coil of the spiral is bent at a sharp angle, which fits into a slot in a spindle, securing the two parts firmly together. The projecting ends of the spindle are rigidly held in bearings, so that the flap is always in its correct position over the port. It will be seen that the entire opening of the port only entails a minimum coiling strain on the spiral, which is therefore of unlimited durability. Nevertheless, the spiral exerts sufficient spring power to close the flap gently immediately the current of water ceases.

The prominent feature of these valves is their extreme lightness. In the pump illustrated in fig. 4, the weight is less than 6 oz. each, and of this, only the flap, weighing less than 1½ oz., is put into motion. These flaps will stand a pressure of 150 lb. per sq. in., and can be made for any pressure up to 1,000 lb. per sq. in.

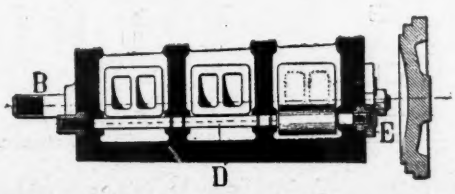


Fig. 3.—Conical Valve Cage, "Excelsior" Pump.

Figs. 2 and 3 show the arrangement of the suction and delivery valves for the pump shown in fig. 4; for all three barrels they are fitted in one conical valve cage. The latter can be bodily withdrawn from the pump, if desired, by removing one end cover.

Fig. 4 illustrates a vertical three-throw high-speed pump, driven through single reduction gear by a 2-b.h.p. Aston shunt-wound motor with a speed of 1,400 r.p.m.; this pump can be seen running at the Exhibition.

W. H. Willcox & Co., Ltd.

Messrs. Willcox's well-known specialities, which include anything from lubricating oils down to pumps, injectors, engine fittings, boiler mountings, and leather belting, occupy stands Nos. 138 and 139.

T. H. & J. Daniells, Ltd.

Messrs. Daniells are exhibiting one of their 25-b.h.p. improved suction gas plants, which is utilised for driving two engines. One of these is a 14-h.p. engine of modern type, and operates a Westinghouse dynamo through a belt drive. The other engine is a converted Trusty oil engine, and its satisfactory running since alteration illustrates a branch of business in which the firm specialise.

The Daniells plant offers special facilities for rapid starting up, and is adapted for working on fluctuating loads.

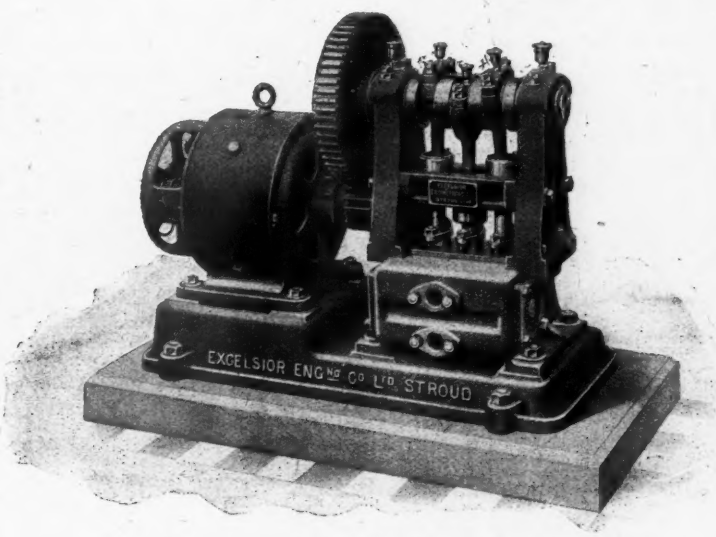


Fig. 4.—Electrically-driven High-speed "Excelsior" Pump.

Consolidated Pneumatic Tool Co., Ltd.

The exhibit of the Consolidated Pneumatic Tool Co. comprises, among other things, a number of portable electric drilling and grinding machines. This firm make machines which are cooled by forced ventilation, and, therefore, have ventilating openings on either end, as will be clear from fig. 1, which shows a machine capable of drilling 1¼ in. holes. The machines exhibited include a breast drill, drilling up to ⅝ in. and a series of tools capable of drilling holes from ½ in. to 2¼ in. diameter. Practically all the

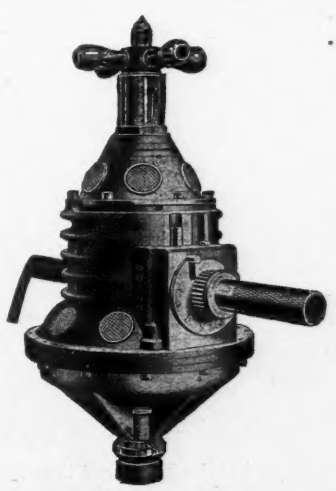


Fig. 1.—Ventilated Portable Electric Drill.

tools have a planetary gear which distributes the strain on the gear of the machine equally all round the shell; in this respect the mechanical construction of the machine is superior to that of many tools, because the frame work is not subjected to any twisting strain, which would be the case if spur gearing were used.

The larger machines capable of drilling from 1½ in. to 2¼ in. dia. holes have two or three armatures running in a common field. A machine having two armatures is shown in fig. 2. The arrangement of the armatures and the disposition of the field and the exciting coils of

a three-armature machine will be clear from fig. 3. It is claimed that such multi-armature machines are lighter than drills with a single armature of corresponding output.

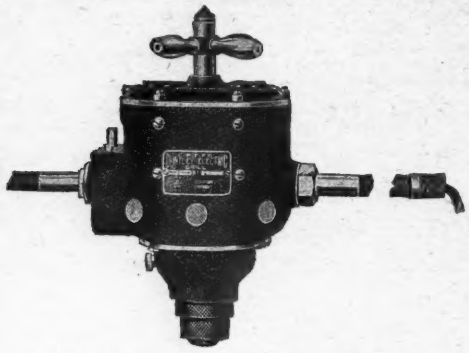


Fig. 2.—Two-armature Electric Drill.

A hand electric grinding machine is also on view, having an emery wheel 5 in. × ½ in. This machine is used principally for grinding off the ends of girders after they have been cut, or removing the

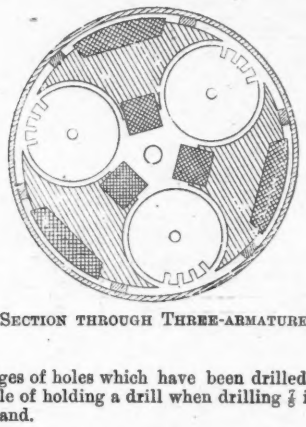


Fig. 3.—Section through Three-armature Drill.

rag from the edges of holes which have been drilled. A magnetic drill post capable of holding a drill when drilling ⅞ in. holes is also shown on the stand.

J. H. Heathman & Co.

This firm are exhibiting specimens of their well-known ladders, which find favour for a variety of purposes; Messrs. Heathman's tower wagons and ladders for arc lamp and trolley wire repairing are already very familiar to our readers.

Boardman Bros.

Messrs. Boardman are showing a great variety of their speciality "Kleenall Cloth." This is made from the finest quality cotton yarn spun and woven by a special process, so as to render the material as absorbent as possible. It is claimed that no material on the market can compare with it for cleaning purposes, it being free from dust and grit, and also from fluff or loose ends. It is much more economical in use than the ordinary cotton waste or mutton-cloth, owing to its greater power of absorption, and it can be cleaned if required by rinsing through soda-water. It is especially recommended for cleaning commutators. "Kleenall" can be obtained in various size rolls, and if it is desired colours can be woven in as a distinguishing mark. This cloth is also cut into squares, hemmed and bound, thus enabling it to be washed many times. Messrs. Boardman also show their Royal Mail and Antifrix packings, much of which is in use in power stations throughout the country.

Crossley Bros., Ltd.

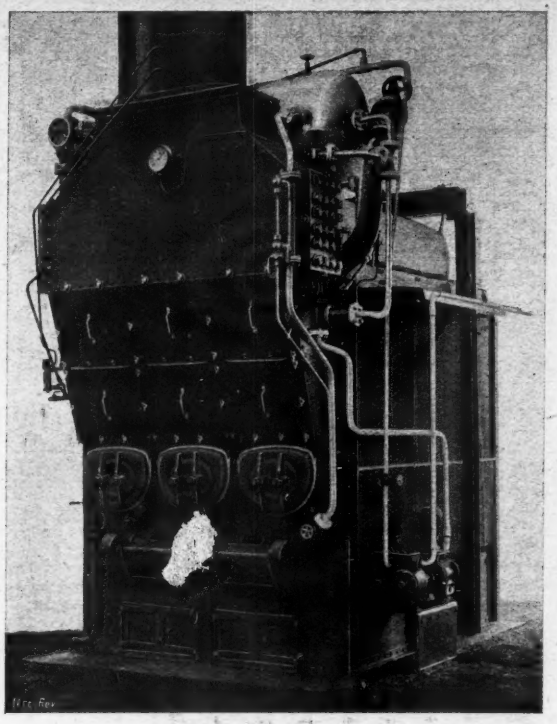
This firm exhibit two of their well-known gas engines and a suction gas plant. One engine, of the high-speed electric lighting type, is direct coupled, by means of a flexible coupling, to an electric generator, utilised for lighting the stand. The engine runs at 220 R.P.M., and will develop 39 B.H.P. on suction gas and 49 B.H.P. on town's gas.

Another slightly smaller engine is employed in driving machinery in the exhibition; both engines run on suction gas from the plant on view, and are fitted with electric ignition.

The Davies Patent Boiler, Ltd.

The merits of the Davies boiler have already received due recognition in our pages, a lengthy and illustrated description appearing as recently as August 24th last.

In design the boiler follows common-sense lines, which we need hardly add, include a furnace and combustion chamber so arranged as to ensure the best possible utilisation of the heat generated; an

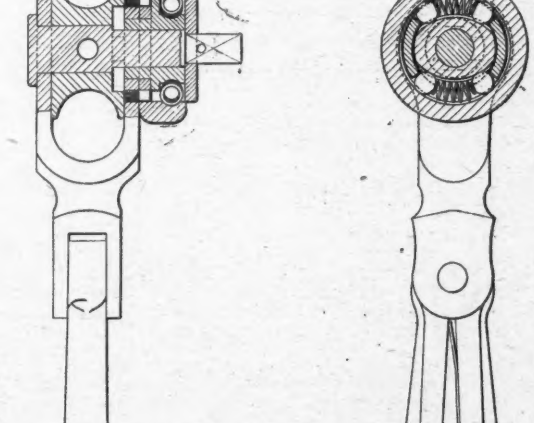


The Davies Patent Boiler.

efficiency of over 86 per cent. is claimed, as the result of authoritative tests. Our illustration shows the boiler installed at the exhibition for the purpose of supplying the exhibition generating plant.

The Autoloc Syndicate, Ltd.

The "Autoloc" is a patented automatic irreversible locking device of very simple design, and susceptible of profitable application in various directions. It is especially suited for replacing



Telegraph Draw-tongs, with "Autoloc" Attachment.

ratchet movements, notched quadrants, &c., doing away with their accompanying hand grips, triggers, pawls and springs.

The device will be better understood by reference to the illustration here given of a telephone and telegraph draw tongs, on which the ratchet movement for holding the wire in tension is replaced by the "Autoloc." In this case the locking device is in duplicate; it consists essentially of two balls lying in an annular space between a projecting oval-shaped boss of the straining pulley and an outer casing or cup. Each pair of balls is separated by a spring, which forces them apart into the narrow parts of the annular recess, as shown in the illustration.

To put strain on the wire, the central spindle is rotated in either direction by a lever or "tommy bar" fitting over the square end of the spindle. This spindle in turning first moves the two lugs, shown in our view, separating the pairs of balls, unlocking the latter; then rotates the pulley with its oval projection (by a loose connection not clearly shown) thus putting on the strain. The tendency of the pulley to run back is obviously checked owing to its oval projecting boss locking with the balls and outer casing.

The device is, of course, applicable in any number of ways, and is especially suited to apparatus exposed to vibration.

BUSINESS NOTES.

The Secrephone.—Some time ago we noticed the introduction of this device, which is an attachment fitting the mouthpiece of the standard patterns of transmitter, by means of which it is possible to carry on conversations in an undertone; the chief advantage of this is, of course, to do away with the annoyance and interruption commonly experienced by persons at work in an office when someone is using a telephone in the same room, and our experience shows that this object is admirably attained. The makers (the Secrephone Co., of 10, Coleman Street, E.C.) have now modified the design of the apparatus by substituting aluminium for the ebonite parts, which were liable to breakage, and we understand that the device has met with a cordial reception at the hands of telephone users. The same company make the "Telaupad," a rubber cushion for the receiver, which excludes external sounds and prevents the pain experienced when the receiver is held to the ear for a long period.

New Illuminated Sign.—Last week we paid a visit to the offices of Messrs. Horace Simon & Co., at 2, Mincing Lane, E.C., to see a new automatic sign which they have brought out. Unfortunately, patent considerations prevent us from describing the details of the invention, though we hope to do this on a future occasion; all we can say for the moment is that by an extremely ingenious and simple device, striking and ever-changing colour effects are produced with the minimum expenditure of energy, and at small capital cost. The pictorial or other designs can be changed as often as desired without affecting the mechanism, the whole apparatus is portable and waterproof, and both front and back of the sign are equally effective. It can be used in or out of doors, connection being made by means of a flexible cord and plug, and it serves perfectly well as an unilluminated sign in the daytime. Those who are interested in electric signs can obtain further particulars on application to the makers.

Nernst Lamps.—A large installation of the "Multiple" type Nernst lamps can be inspected at Messrs. Edwards & Co.'s premises in Tottenham Court Road, W.C. Messrs. Edwards are, we understand, prepared to give any information required. The lamps were supplied by the Electrical Co., Ltd., of Charing Cross Road. We are informed that for street lighting Nernst lamps have been particularly successful, lamps being supplied by the Electrical Co., Ltd., to considerably over 100 electric lighting stations.

Book Notices.—*Battery Record Book.*—This a log-book which has been issued by the A.B.P. Accumulator Co., Ltd., of Stockton-on-Tees, for the use of battery attendants. It is prefaced by a brief set of instructions on the management and care of accumulators, and diagrams of connections. The remainder of the book consists of ruled record forms, each of which provides a column of entries relating to the state of the battery, amount and duration of charge, &c., on each of 16 days. Spaces are provided for remarks and for the signature of the attendant. Methodical inspection and systematic recording of facts are the life and soul of battery attendance, and a log-book of this kind ought to be religiously used by everyone in charge of a storage battery.

Telpherage Electrique.—By E. Guarini. Paris: H. Dunod and E. Pinat. Price 2 fr.—In this brochure the author describes the recent advances which have been made in the application of electricity to telpherage, with a large number of illustrations of actual examples, mainly drawn from the United States. These include aerial cable-ways and rigid structures, some of which are employed for passenger as well as goods traffic. The advantages of the system in new and undeveloped countries are obvious, but it has also a wide scope elsewhere and might often be usefully applied in this country, where it is at present represented by very few examples. Prof. Guarini's work, therefore, should be of considerable utility.

L.G.O. is the name of a publication which commenced appearing a few weeks ago in London (50-52, Ludgate Hill, E.C.). It is not an organ concerning itself with the interests of omnibus shareholders, for L.G.O. means *Local Government Officer*. It can hardly be called a new journal, for it is our old friend the *Public Health Engineer* under the altered title and in an improved form. It takes its title from the fact that it is the official organ of the National Association of Local Government Officers.

Messrs. Stanley, Popplewell & Co., Ltd., patent agents, of Chancery Lane, have issued a three-fold circular giving some general information concerning the new Patent Law.

"Turbines." By W. H. Stuart Garnett. London: Geo. Bell and Sons. 8s. 6d. net.

"Report of the Council of the City and Guilds of London Institute to the Members, 1906." London: Head Office, Gresham College, E.C.

"Alternating Currents." By C. G. Lamb. London: Edward Arnold. 10s. 6d. net.

"Modern Buildings, their Planning, Construction, and Equipment." By G. A. T. Middleton, A.R.I.B.A. Vol. IV. London: The Caxton Publishing Co. 10s. 6d. net (per volume).

"Science Abstracts." Parts A. and B. Vol. 9, No. 105, Sept. 25th, 1906. London: E. and F. N. Spon, Ltd. 1s. 6d. net each part.

"Electricity of To-day: Its Work and its Mysteries." By Chas. R. Gibson. London: Seeley & Co., Ltd. 5s. net.

"Journal of the Franklin Institute." Vol. CLXII, No. 3, Sept., 1906. Philadelphia: The Institute. 50 c.

"Journal of the Western Society of Engineers." Vol. XI, No. 4, August, 1906. Chicago: The Society. 50 c.

The following books are published by Messrs. E. and F. N. Spon, Ltd., 57, Haymarket, W., and in New York by Messrs. Spon and Chamberlain, 123, Liberty Street:—

"English Weights with their Equivalents in Kilogrammes." By Fredk. W. A. Logan. 1s. net.

"The Stoker's Catechism." By W. J. Connor. 1s. net.

"Experimenting with Induction Coils." By H. S. Norrie. 1s. 6d. net.

"A Treatise on the Grouping of Electric Cells." By W. F. Dunton. 1s. 6d. net.

"The Management of Electrical Machinery." By F. B. Crocker and S. S. Wheeler. Sixth edition. 4s. 6d. net.

"The Care and Management of Electric Plants." By N. H. Schneider. Revised edition. 5s. net.

"The Smith and Forgeman's Handbook of Practical Smithing and Forging." By Thos. Moore. 5s. net.

Exhibition Awards.—The Frictionless Engine Packing Co., Ltd., have been awarded a gold medal at the Milan Exhibition. This makes the second gold medal received this year for the company's exhibits of "Karmal" packing and "Roko" belting, the other awarded being from the Tourcoing Exhibition, France.

India.—From *Indian Engineering* we learn that the G.E. Co., Ltd., has recently executed a large order for arc lamp carbons for the Bengal Nagpur Railway.

The Phœnix Dynamo Manufacturing Co. has in hand an electric drill, together with a set of high-speed drills, for the Khargpur Workshops of the Bengal-Nagpur Railway.

The British Westinghouse Co. is supplying the East Indian Railway with four transformers and a 40-B.H.P. motor, together with spare parts, for the loco. department.

Catalogues and Lists.—Messrs. H. G. Mayer & Co., 67, Aldersgate Street, London, E.C.—A number of illustrated pamphlets concerning their special lines. The Thomas soldered rail-bonds as made by the Lord Electric Co., of Boston, U.S.A., are described in detail, the method of their application being well and interestingly shown; a second publication gives in the course of some eight pages, an account of the carbon works of Messrs. Schiff and Co., of Schwechat, Vienna, with views showing the different processes connected with carbon manufacture in progress; a third and smaller list gives prices of arc lamp carbons for open and enclosed and flame lamps; another list shows illustrations of carbon brushes; while yet another is a finely illustrated catalogue with prices of the various different types of Nernst lamps and fittings, reflectors, accessories, &c., for same. As recently announced the firm has lately opened a special department for the sale of these lamps.

General Electric Co., Ltd., London, E.C.—To be abreast of the times, the publicity department of a concern with such wide and varied interests and manufactures as the General Electric must be ever on the alert producing something which shall command the notice of the trade. This department has, as the latest example of its energy, produced a couple of impressive show-cards of Robertson lamps for traders to display indicating that these lamps are "sold here," also that they "last longest, burn brightest and save current." The design adopted fixes the word "Robertson" indelibly on your mind—you cannot get rid of it. One of the show-cards is a standing device for counter use. Several new pamphlets have just been issued. One gives some hints to the user as to when to change his lamps so as to economise current consumption. One is a picture-card depicting a yacht, whose sail bears the words "On Sale Everywhere;" on turning back the sail we find the Robertson lamp taking "a shift" for the sun. Another assumes the form of a little folding card, showing how illumination matters went from bad to worse—torch! candle!! oil lamp!!! then gas!!!!—until the Robertson lamp came along to set things right. Each stage is represented by a more or less appropriate attempt at illustration, and beneath each is some versification of the order, "The boy stood on the burning deck, Roasting chestnuts by the peck."

The Carron Co., Carron.—Eight-page circular giving illustrations of the "Carron" gas and water pipes and connections, flange pipes and flange pipe connections. Tabulated figures of sizes and weights are given.

Simplex Conduits, Ltd., Birmingham.—Circular concerning their sample cabinets of the Simplex steel conduit system, which they are issuing for the forthcoming season. They will be pleased to hear from the principals of technical colleges who are able to make use of these for lecture, demonstration, conversazione and such like purposes.

Bradford Electrical Engineering Co., Bradford.—Price card of Cassé's "Royalite" lamps.

Marconi Wireless Telegraph Co., Ltd., 18, Finch Lane, E.C., and Dalston.—New catalogue (32 pp., 6¼ in. × 8½ in.) containing a detailed description, with diagrams and general illustrations, of the direct-reading cymometer, designed by Dr. J. A. Fleming, F.R.S., together with full instructions for its use. The company are now able to provide cymometers to cover the whole range of waves used in wireless telegraphy and to supply special adjuncts to enable the instruments to be employed for the measurement of the decrement of the oscillations in an oscillatory circuit.

The Frictionless Engine Packing Co., Ltd., Harpurhey, Manchester.—Lists relating to two kinds of packing lately introduced by the company, one specially designed to meet the demand for packing to withstand boiling water, and the other to stand the perhaps still more severe test of ammonia in pumps.

Messrs. Crompton & Co., Ltd., London, E.C.—Illustrated pamphlet (D 27) in their usual style and size (6 in. × 9 in.), setting forth in some 28 pp., finely illustrated descriptions of their alternating-current motors and generators. Generators, sub-station converters, induction motors, single, two and three-phase motors, starting transformers, main switches and motor panels, all come in for description, and tabulated data concerning outputs, speed, voltages, prices, shipping dimensions appear, some useful formulæ and general notes bringing up to the rear.

Chloride Electrical Storage Co., Ltd., 39, Victoria Street, S.W.—For the benefit of engineers in charge of plants and all who have anything to do with the working and management of battery installations this company has issued a useful instruction book of 36 pp. on the care and operation of the "Chloride" accumulator. Notes on such matters as charging, discharging, taking records, inspecting cells, and the causes and effects of troubles, are included among this general collection of information which, put briefly, tells what to do and what to avoid. The battery room, its lighting, ventilation, cleanliness and so forth are discussed, and there is a description of apparatus and accessories required to render an installation complete. A glossary of battery terms and definitions is also included.

For Sale.—Messrs. Wheatley Kirk, Price & Co. are offering the premises, works, plant, &c., of the Industrial Engineering Co., Ltd., Newton, Hyde, for sale by private treaty, by order of the receiver. Some particulars appear among our advertisements this week.

The Price of Copper.—The copper statistics for the end of the month (September) exhibit a further reduction in stocks, the total being 7,658 tons, or 780 less than a fortnight ago, and slightly under even the low figure recorded at the close of August. Thanks, however, to the larger shipments afloat from Australia, the visible supplies of 12,483 tons are 220 tons up, so that statistically there is small reason for the advance in the quotation during the fortnight from £86 17s. 6d. to £91 2s. 6d. per ton, which was the high level reached at the close of September. The total supplies for the month were a few hundred tons ahead of the deliveries, notwithstanding that the American shipments were 4,300 tons less than in August and below those of any month since April last. The very high comparative value at which the metal stands now may be gauged from the fact that at the end of September, 1904, when the visible supplies were only 600 tons above those available at present, the quotation stood at no more than £58 per ton, or £35 below the current price.—*Financial Times.*

Dissolutions and Liquidations.—The Empire Electric Light and Power Co., Ltd.—A compulsory winding-up order having been made against this company, described as of Effingham House, Arundel Street, Strand, W.C., the statutory first meetings of the creditors and shareholders, were held on Tuesday at the Carey Street offices of the Board of Trade, Lincoln's Inn, W.C. Mr. H. E. Burgess, Official Receiver, presided; and Mr. Foy (Busk, Mellor & Norris) attended for the Tudor Accumulator Co., Ltd., upon whose petition the winding-up order was made on August 22nd last. Proofs to the amount of £20,224 were tendered on behalf of creditors. The chairman reported that the company was promoted in November, 1902, by Mr. Alfred Slatter, assisted by Mr. J. Paxman, with a nominal capital of £50,000 subsequently increased to £100,000. Mr. Slatter had entered into arrangements with the Chesham and Romford District Councils to supply them with electric power for lighting and tramway purposes, and the company was promoted to pass on the benefit of the contracts, Mr. Slatter being personally unable to finance such extensive undertakings. His salary as managing director was originally fixed at £500 per annum, but was reduced from October, 1904, to £250 per annum. He also acted as secretary and electrical engineer to the company, and now claimed to be a creditor for £825 in respect of salary, &c., and a further sum in lieu of notice. The company agreed to give Mr. Slatter £3,500, payable half in cash and half in fully paid shares in consideration for his interest in the Chesham electric lighting undertaking, the Romford electric lighting order, and the Romford Electric Tramway Act. Only £1,000 of the purchase price had been paid in cash, which was immediately reinvested in shares of the company, and the fully paid shares had not been allotted. A prospectus was issued in November, 1903, privately to friends of the directors, offering 87,142 shares for subscription. Altogether 14,626 shares had been issued for cash. Shortly after promotion, the company took steps to acquire from various public bodies the right to supply them with electric power, and in this way large sums were expended. The only work, however, actually undertaken was the Chesham electric contract, over which the company had expended £24,173. They further disbursed nearly £9,000, with a view to obtaining the Romford Tramway Act, £1,115 over the Romford electric light provisional order, £518 over a similar order for Halesowen, and £129 upon sundry other electrical negotiations. The £14,000 subscribed for shares, together with £6,200 obtained on loan from the bankers was expended, and the company now owed nearly £20,000 to unsecured creditors, and £1,100 on second debenture bonds issued to their solicitors in satisfaction of their claim to £2,200 for costs. The statement of affairs had not been lodged, but was in course of preparation, and a summary of it, together with full observations upon the failure, would shortly be issued to the creditors and shareholders. The freehold property at Chesham, consisting of the land, buildings, machinery, mains, &c., was valued at over £20,000, and the other assets comprised a deposit of £1,301 with the Paymaster-General in connection with the Romford tramway scheme; cash, £33; stock-in-trade, £510; and book debts, £434. Mr. Walter Allnutt, incorporated accountant, 5, Lime Street, E.C., was, on August 23rd last, appointed receiver and manager for the first debenture-holders of the undertaking at Chesham, and he was carrying on the contract there. Mr. T. O. Callender (Callender's Cable and Construction Co., Ltd.) supported a resolution moved by another creditor, that Mr. Allnutt should fill the post of liquidator. He stated that it was intended to form a new company that would take up the old company's undertakings and carry them through. An amendment was moved by Mr. A. B. Pescatore, representing the petitioning creditors, that Mr. C. Middleton Kemp should act as liquidator, but after a discussion the amendment was withdrawn, and Mr. Allnutt was unanimously elected to the post. The following gentlemen were selected as members of the committee of inspection, viz.:—Mr. T. O. Callender (Callender's Cable and Construction Co.), Mr. A. B. Pescatore (The Tudor Accumulator Co., Ltd.), Mr. W. C. C. Hawtayne (Hawtayne and Zeden), Mr. E. V. New (New & Son), and Mr. Wm. Paxman (Davey, Paxman & Co., Ltd.).

Messrs. Wharam & Borland, Grove Engineering Works, Claypit Lane, Leeds.—Messrs. W. Wharam and F. J. Borland have dissolved partnership. The assets have been assigned to Mr. Alfred Hutley, 50, Albion Street, Leeds, for realisation and for the purpose of winding up. The sale has been fixed for October 22nd and 24th. Claims against the firm should be notified to Mr. Hutley.

Electrical Turnery, Ltd.—This company is winding up voluntarily, with Mr. T. M. Gordon, 1, Kenway Road, Earl's Court, S.W., as liquidator.

Benham & Froud, Ltd.—Mr. W. B. Peat, the Receiver and manager, notifies that the works of this company are closed down from September 29th, and no further orders will be issued by him or on his behalf.

International Electric Traction and Power Syndicate, Ltd.—A meeting is to be held at Northern Assurance Buildings, Albert Square, Manchester, on November 9th to hear an account of the winding up, from the liquidator, Mr. John Morris.

Trade Announcements.—In consequence of their removal from Bradford to Doncaster, all goods and communications intended for the works or registered offices of the Rhodes Electrical Manufacturing Co., Ltd., should be addressed to them at Riverside Works, Doncaster.

The offices of the River Plate Electricity Co. have been removed to 79, Coleman Street, E.C.

The address of the offices, factory and warehouse of the Union Cable Co., Ltd., has now been altered to Eagle Wharf Road, London, N.

Consequent upon increased business in carbons, incandescent lamps and electrical accessories, the Sloan Electrical Co., Ltd., have taken further premises at 11, Fore Street Avenue, E.C.

The Small Power Dynamo and Motor Co. have removed to Old Lane, Openshaw, Manchester.

Electric Derricks for Hamburg.—According to the *B. of T. Journal*, tenders were recently invited for 18 electric derricks for the Customs Harbour on the Veddel.

LIGHTING and POWER NOTES.

Acton.—At a meeting of the Council this week a resolution was carried protesting against the Council embarking upon municipal trading. It was estimated that £7,314 would be realised from the sale of electricity for the whole year; the actual takings for one quarter were £1,012.

Barking.—The U.D.C. has decided to supply energy to owners for groups of not less than 12 houses at 3d. per unit.

Both the L.G.B. and the B. of T. have informed the Council that they have no authority to grant powers for hiring out motors, electrical apparatus, &c., and the L.G.B. has also intimated that it would seem that the Council is not authorised to execute any repairs upon consumers' premises beyond the terminals.

Bray.—The U.D.C. electricity undertaking was one of the first to be put down for public supply in the U.K., it being originally started by Messrs. J. E. H. Gordon & Co. in 1891, and purchased by the U.D.C. in 1896. Considerable additions to the generating and distributing plant were carried out in 1894. The arc lamps in use for street lighting until recently were of the first Brockie-Pell type manufactured by Messrs. Johnson & Phillips, and fitted in lanterns similar to those erected in the City of London in 1891. These lamps, which had been in continuous use for 15 years, have now been replaced. Swan-neck brackets have been fitted to

the existing pillars in the principal thoroughfares, and handsome carriers to the pillars along the sea front. The new arc lamps were supplied by the Gilbert Arc Lamp Co., and are of their double carbon type, burning 30 in series on an alternating 60 ~ circuit. The work has been carried out to the specification and under the supervision of Mr. W. J. U. Sowter, electrical engineer to the U.D.C.

Canada.—Emerson (Man.).—A project is on foot to establish an extensive water and power plant on the Roseau River, at a point about 22 miles from the town. Experts have been over the ground, and report that the scheme is one that is likely to prove very profitable. The volume of water passing over the bed is sufficient for the development of 12,000 H.P. The initial cost for installing a dam and plant, sufficient to meet all demands for light and power within a radius of 40 miles, has been approximately estimated at $200,000.

Ottawa (Ont.).—The Ontario Hydro-Electric Power Commission has now decided to furnish a public power plant for the city under the provisions of the recently enacted power Bill, passed by the Legislature. With this object in view, the commission has sent its chief engineer, Mr. P. W. Sotham, to the city to look into the situation. The Chandiere Falls, on the outskirts of the city, are mentioned as admirably adopted to meet the Commissioner's requirements.

Ontario.—Many cities in Ontario are applying for a supply of electric energy for power. The Berlin Municipality has applied for 3,000 H.P. per annum; London, 10,000 H.P.; Waterloo, 900 H.P.; Galt, 2,900 H.P., while the City of Toronto a short time ago applied for 30,000 H.P. from the Great Cataract. Port Arthur requires immediately 2,000, and has made a further application for 20,000 H.P. to be taken from Dog Lake, 30 miles from the city.

Continental Notes.—France.—The French Minister of Public Works has appointed, as members of the committee of electricity, in accordance with the law of June 15th, 1906, 15 professional representatives of large French electrical undertakings, and 15 members representing the departments of the interior, public works, post and telegraphs, war and agriculture. M. Mascart has been appointed president, and M. Monmerqué, secretary.

Switzerland.—Plans are being prepared for a generating station of a capacity of 3,400 H.P., which it is proposed to establish at Ragoz.

Turkey.—La Société des Tramways et de l'Electricité de Beyrouth has lately been floated in Brussels with a capital of £144,000, to acquire and work a concession for electricity supply, and a system of electric tramway in the town of Beyrouth.

Italy.—La Società Elettrochimica Pont St. Martin has secured a concession from the provincial authorities of Turin to erect a plant on the River Dora Baltea for generating electrical energy for power purposes.

The British Consul at Venice reports that the Cellina hydro-electric installation is now working, and the principal industries in the town are being supplied with electrical energy.

A Rome paper states that recent statistics compiled by the special commission appointed to inquire into the water powers of Italy show that about 5,000,000 H.P. is available in the country.

Spain.—The municipal authorities of Viver (Castellon) and Cebolla (Toledo) have lately invited tenders for the electric lighting of their respective towns.

Cotton Mills.—A Lancs. correspondent says that Messrs. Thos. Dugdale Bros. & Co., of Blackburn, have decided to adopt electrical driving in the Griffin mill, which contains nearly 100,000 spindles.

Dudley.—The T.C. proposes to borrow another sum of £3,000 for additional mains. Arrangements are being made with a London firm to let out electrical motors on the hire system.

Durham County.—A special meeting of the C.C. was held on the 26th ult. to consider, *inter alia*, a number of resolutions which had for their object the taking of preliminary steps towards inquiries as to the proposed establishment of a system of electric supply by the county. It was moved that the Electric Supply Committee be reappointed to resume its inquiries, and to report as to various particulars in connection with the proposed scheme. The resolution was ruled out of order. Another motion was then put expressing the opinion that the Council had power to promote Bills in Parliament, and asked that the clerk be instructed to give the necessary notices that a resolution would be put to the next meeting, that a Bill be promoted in Parliament for a county scheme of electric supply for Durham, but this was rejected by the casting vote of the chairman. Other resolutions provided for the collection of various particulars as to the powers, obligations, failures to carry out obligations, &c., by existing private schemes of electric service in the county, and for asking the clerk to advise as to the mode of procedure to be adopted to secure the amendment of the terms upon which existing companies had secured monopolies of service in the county. These resolutions were carried.

Epsom.—The U.D.C. has decided to extend the electric cables at a cost of £232, and to light two roads with 35 tantalum lamps.

Hornsey.—A municipal electrical exhibition, in which Mr. N. Staniland, the borough electrical engineer, is the moving spirit, was formally opened in the Christ Church Schoolroom on Tuesday by the Mayoress. Among the well-known firms exhibiting, may be mentioned the Western Electric Co., and the Dowsing Radiant Heat Co., the latter prominent with its electric heating apparatus. A number of local firms are also taking part. Art metal lighting fittings, of which there are a large variety, make a very attractive display. Unfortunately for the borough undertaking, there is little prospect of a substantial day load, as there are practically no industries within its area. Judging by the amount of literature on the Electricity Department's stand at the exhibition, the Department is fully awake to the fact that it is necessary to push the sale of energy. With a view to increasing the number of electrically lighted shops, the Electricity Committee has decided to supply energy for arc lighting at a fixed price per quarter, or per annum, with a specified number of hours' consumption, a clock meter being provided to register the number of hours run. A little booklet giving detailed information respecting this departure has been issued by the borough electrical engineer. Admission to the exhibition is free and it closes to-morrow.

India.—Gersoppa Falls.—For sentimental reasons the Government of Bombay has refused the application of Messrs. Eardley Norton & Sutherland, of Madras, for a concession for the use of that portion of the water power of the falls which lies within its jurisdiction, for the purpose of supplying electrical power for smelting manganese ores and for manufacturing steel from iron ore. *Indian Engineering* says:—The applicants were informed that previous applications for the water power of these falls had been received and refused, that the Government of India considered that any industrial or economic advantage would be dearly purchased at the permanent sacrifice of one of the greatest wonders of the Eastern world, and that under no conditions could a company be permitted to make use of the water power of the falls.

Jamalpore.—The generating plant in the electric power house at the Jamalpore workshops of the East Indian Railway, notwithstanding a recent addition, is still found inadequate to fully meet requirements. It is accordingly contemplated to provide an additional 300-KW. turbo-generator, with the necessary accessories &c., in the existing power-house. The supplemental installation is estimated to cost a sum of about £5,000.—*Indian Engineering.*

Roorkee.—An installation of electric light and fans and overhead supply lines for the Thomason Civil Engineering College Buildings, is to be put down, and tenders were recently invited for carrying out the work.

Japan.—The British Consul at Kobe reports that there is now under consideration a plan to furnish electricity to Osaka and Kioto. The power house will be established at a village some 28 miles distant from Osaka and about 8 miles from Kioto, and it is stated that with the water power available about 32,000 KW. can be generated. No special scheme has as yet been decided upon, but it is hoped that British manufacturers and capitalists will secure at least a share in the undertaking.

London.—Shoreditch.—An L.C.C. loan of £23,555 is to be taken up by the B.C. for E.L. purposes.

Malvern.—On September 25th a L.G.B. inquiry was held into the application of the U.D.C. for a loan of £4,500 for E.L. purposes. It transpired that £1,630 represented money already spent. The inspector objected to certain "etceteras," and eventually the sum asked for was reduced to £4,334. There was considerable opposition on the ground that the undertaking was unprofitable.

Portrush (Co. Antrim).—The U.D.C. has, on a recommendation by its Lighting Committee, decided in favour of an agreement between the Council and Messrs. Curran Bros., of Belfast, for lighting the town by electricity.

Salford.—The Electricity Committee has recommended the T.C. to adopt an alternative charge for energy for power of £1 per quarter per B.H.P. demanded and ½d. per unit.

Stourbridge.—The U.D.C. has submitted to the B. of T. a draft deed transferring the E.L. order to the Shropshire, Worcestershire and Staffordshire Electric Power Co.

South Africa.—East London.—Mr. J. Mordey Lambe, the municipal electrical engineer, has presented to the Council his report as to the advisability of the Corporation accepting the offer of the East London Harbour Board, to sell to the Council its generating station and plant at present being used for the purpose of lighting the wharves, offices, &c. The offer of the Harbour Board was to sell the station and plant outright at cost price, including the cost of raising the loan and interest to June 30th last, for £39,019; the land on which the station stands to be handed over in exchange for other land belonging to the Corporation. The Harbour Board further stipulated that it should be supplied by the Council with all the energy it required at 3d. per unit.

Mr. Lambe, in his report, says that the buildings are, in his opinion, of excellent design and construction, whilst the plant and operating arrangements are also the best that could have been adopted for a station having an output such as this station has at present, and then points out the alterations necessary to increase the coal storage capacity and render the bunkers suitable for use with mechanical stokers; he also proposes to re-erect two of the existing water-tube boilers from the Council's power station at the Harbour Board station; and to replace the existing generating sets by the larger sets last installed in the Council's power station, as, in his opinion, the generators in the Harbour Board station are unsuitable for town lighting supply. The condensing plant he proposes to retain, but the switchboard will require very considerable and costly alterations. The Harbour Board station being on the west bank of the Buffalo River, whereas the bulk of the town of East London (including the Council's station and the whole of the tramway system) is on the east bank, the question of cables under or over the river has been considered by the electrical engineer, and he advises that cables be laid in the bed of the river, which would have to be dredged for the purpose. The following is the estimated cost of

carrying out the necessary alterations and additions to the Harbour Board station, including the necessary cables, &c.:—

Re-erection of two Babcock & Wilcox boilers taken from Council's power station	£1,600
Water purifying plant	800
Coal-conveying plant	4,000
Piping	700
Two 500-kw. alternators	9,000
Combined 400-kw. set	8,600
200-kw. D.C. generator to meet Harbour Board requirements for power (to be coupled to engine at present in Council's station)	600
Switchboard	1,200
Mechanical stokers for Lancashire boilers	1,200
Superheaters	600
Additional cost of cables, &c.	4,050
Contingencies and sundries	750
Making a total expenditure of	£27,600

The total cost, however, of reorganising the electric light and tramways scheme, should the Council decide to purchase the Harbour Board station, instead of erecting an entirely new power station as previously proposed by Mr. Lambe, would be as follows:—

Cost of alteration and equipment of Harbour Board station as above	£27,600
Purchase price	39,019
Reconstructing distribution system	7,500
Alterations to tramways	5,000
	£79,119

Say, £80,000 as compared with a total estimated cost for building and equipping an entirely new power station of £50,000. Mr. Lambe concludes his report by saying that he has consulted Mr. Roberts, the borough electrical engineer of Durban, who expresses his entire agreement with the main points set forth in his report, and expresses the opinion that it would not be to the advantage of the Corporation to purchase the Harbour Board station, but recommends the building of an entirely new station.

The T.C. has decided to adopt the report of Mr. Lambe, and to take the necessary steps to proceed with the building of the new power station.

Walthamstow.—Upon the recommendation of the electrical engineer, the following reduced charges for energy for lighting will come into effect at the end of the December quarter:—First 750 units, 4d. per unit; second 750 units, 3½d.; all above, 3d. The following scale of charges for energy for power will also come into effect at the same time:—Up to 250 units per quarter, 2d. per unit; for the next 3,750 units per quarter, 1½d.; for all in excess of this number, 1d. As a further inducement to power consumers they are to be allowed energy for lighting purposes up to 10 per cent. of the amount used for power at 2d. per unit. The question of establishing a showroom and advertising the electric light has been referred to a special committee. The Council on Friday adopted a hire-purchase scheme for the supply of arc lamps at a charge of £4 per lamp per annum for 500 hours' burning, such sum to include maintenance.

West Bromwich.—The Electric Lighting Committee has issued a report on additional wiring regulations for more effectually ensuring the reliability and safety of electric wiring and fittings on consumers' premises.

West Ham.—The chairman of the E.L. Committee and the electrical engineer have been empowered to represent the Council at the conferences which are proposed to be held between the owners of existing electrical undertakings in London with a view of considering the policy to be adopted in the next session of Parliament.

Worcester.—The L.G.B. has informed the T.C. that with respect to the application for a loan of £5,850 for electrical purposes, it can only sanction £5,109. The deduction includes £458 applied for, for motors, wages of permanent employés, and accumulators. With regard to the proposal to borrow £2,600 for expenditure incurred since March 25th, 1905, the Board is willing to consider it if the loan is applied for. The Electricity Committee has decided to apply for the loan.

Willesden.—An alternative flat rate of 5d. per unit is to be offered to all consumers from the Christmas quarter, on condition that the system of charge selected shall remain in force for at least 12 months.

Wimbledon.—Application is to be made by the T.C. to the L.G.B. for sanction to a loan of £1,000 for 43 arc lamps for street lighting.

TRAMWAY and RAILWAY NOTES.

Acton.—A petition is to be forwarded to the B. of T. by the residents along Acton Vale with respect to the noise occasioned by the L.U.T. tramcars.

Bournemouth.—In accordance with a resolution recently passed by the Council, a poll of the burgesses of the town has been taken for and against the running of tramcars in the borough on Sunday afternoon and evenings. The poll resulted in a majority of 903 against running the cars on Sunday. The T.C. has resolved to adhere to the decision of the ratepayers for three years.

Canada.—Hamilton (Ont.).—Owing to complaints from the citizens of Hamilton against the street railway, the Ontario Railway and Municipal Board has instructed Messrs. Wise and Middlemist, electrical engineers, of Toronto, to make a thorough investigation of the condition of the Hamilton Street Railway.

Glasgow.—At the meeting of the Glasgow District Subway Co. last week, it was stated regarding the electrification of the subway, that the negotiations with London parties had fallen through, and the subject might be dismissed.

The traffic receipts of the Corporation tramways for the week ended September 29th amounted to £18,793, constituting a record week's drawings.

India.—Bombay.—The tramway concessionaires have paid to the Government of Bombay the sum of Rs. 45,000 towards the cost of removing the Magnetic Observatory from Colaba to Alibag.

Rangoon.—The Rangoon Tramway Co. has already run trials successfully, and the opening for traffic was to take place at the end of September.—*Indian Engineering.*

Japan.—The British Consul at Kobe, in a recent report, states that there has been much talk of establishing electric trams in the city of Kobe, and another line communicating with places west of it. The projects have not matured, nothwithstanding that the "Hanjin" or the Osaka-Kobe electric tram or railway has proved a gigantic success. Traffic commenced in April, 1905, and by the end of the year shares had gone up from 55 yen to over 100 yen, and a dividend at the rate of 8 per cent. was declared. The electrification of the Nankai Railway, a line connecting Osaka and Wakayama, is in progress. Actually the company have an existing inter-urban steam railway 40 miles long, 9 miles 5 chains being double track, and 30·5 miles single track. Electric cars are intended to take the place of the local steam trains. The generating station will be at Sumiyoshi (the fifth station out of Osaka). A scheme has been decided on by the Osaka city for an extensive system of electric tramways at a total cost of 22,000,000 yen (£2,000,000). An electric railway between Osaka and Kioto was also contemplated with a capital of £200,000. Such a line running through a fairly populous district, not touched by the railway, should prove successful. There seems very little likelihood of any charters for new electric railways or trams to run in the vicinity of existing railways being guarded in future. The working of the electric railway between Osaka and Kobe (Hanjin Electric Railway) has proved too injurious to Government railway interests.

Leyton.—In spite of its tramway manager's warning against the introduction of ½d. fares over the new electrified tramway system, the Council has instructed the Tramway Committee to report on the matter and arrange for ½d. fares where practicable in the district. The Council has been warned that if the ½d. stages are extended there will be a certain loss of £1,500 annually on the service.

Manchester.—The B. of T. has consented to the laying of a double line of tramway in lieu of the existing single line in Ashton New Road, Manchester Road, and Ashton Road (Droylsden) and Droylsden Road (Audenshaw).

The Tramways Committee has decided that the horses and vans which now deliver parcels to various addresses from the tramway termini shall be abolished. Boys are to be employed to deliver the parcels, and only to short distances.

London.—Woolwich.—A conference was held in Woolwich last week at which 72 trade unions, co-operative and friendly societies, &c., were represented, when a resolution was carried calling upon the L.C.C. to construct tramways to Eltham and Abbey Wood. Mr. W. Crooks, M.P., remarks seemed to imply that the L.C.C. had shelved Woolwich because the Finance Committee was looking after the best paying parts instead of the most needy.

L.C.C.—Two more drivers have been fined by Mr. Hopkins, 10s. and costs, for exceeding the speed limit.

Lambeth.—The B.C. has decided to accede to a request from the L.C.C. to contribute £3,433 to the cost of the necessary street widenings along the proposed route of the tramways in Wandsworth Road. The Highways Committee of the B.C. brought up a report recommending that consent be given to the L.C.C.'s proposal to extend the Norwood tramways to the Crystal Palace. No mention was, however, made of the desired contribution of £10,200 towards the cost of street widenings. The B.C. referred the report back with instructions to the Committee to give further consideration to the application for the £10,300, provided the L.C.C. agreed to the adoption of the underground conduit system.

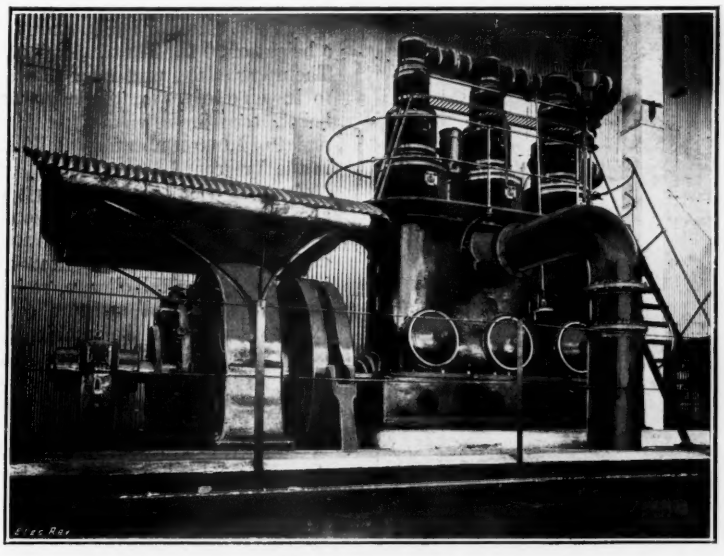
G.W. and Metropolitan Railways.—Trial trips with the new electric trains intended for service over the Hammersmith and Aldgate line have been conducted by the Great Western Railway Co. It is stated that the first electric trains for public use will be run about a fortnight hence; but probably not until the end of January will the complete new service be in operation. It is intended that the service shall be a five-minute one, instead of one of 10 minutes, as at present.

Willesden.—At the last meeting of the U.D.C., the G.P. Committee stated that it regretted to have to report that the B. of T. had decided that no sufficient reason had been shown for the disallowance of by-laws to be made by the Metropolitan Electric Tramways with reference to the carrying of excess passengers on their cars under certain conditions.

(Continued on page 543.)

PERTH (W.A.) ELECTRICITY WORKS.

In our issue of December 8th, 1899, we gave a brief description of the electricity supply undertaking of the Perth Gas and Electricity Co., which at that time had not long completed the change-over to higher voltage. Since that date rapid progress has been made with the extension of the system; new plant has been installed, and an entirely new generating station has been erected to cope with the increasing demand for electricity supply. As evidence of the importance which the electricity department has acquired in the company's affairs, we may mention the fact that last year the output was 2¼ million units, and the total revenue £45,000: the net revenue from the sale of electrical energy was £20,000, while the profits on the sale of gas in the same period were only £7,000. Moreover, the business is still increasing, and in view of the growth of the city, which shares in the prosperity of the progressive State of Western Australia, there is no likelihood that a limit will be reached for years to come.

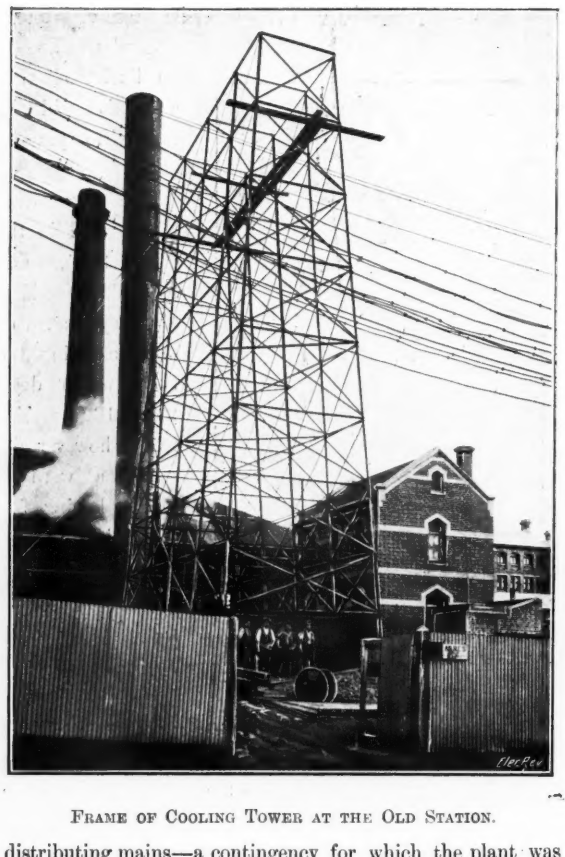


Willans-Dick, Kerr 500-kw. Generating Set.

The new station was erected in the year 1904, and marked a considerable step in advance of the older installation, which dates from 1897. The latter, however, deserves a word of praise, having fulfilled its purpose admirably, often under very trying conditions. Some years ago new plant was ordered to meet the need for extensions but went to the bottom of the sea on its way out, through shipwreck. This resulted in the existing plant being heavily overloaded (not for the first time) for a considerable period, an ordeal through which it came with flying colours. The generators were all of the two-pole type,

View of Steel-frame Building, with Steel Chimney in Process of Erection.

made by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, the original contractors, and were driven by Willans engines; the only breakdown recorded in connection with them was an armature burn-out due to lightning striking the overhead



Frame of Cooling Tower at the Old Station.

distributing mains—a contingency for which the plant was naturally not to blame. The new generating set was of 500-kw. capacity, and consisted of a multipolar dynamo of Messrs. Dick, Kerr & Co.'s make coupled to a Willans three-crank triple-expansion engine. This was first installed in the old station, but was transferred to the new one on its completion.

The construction of the new station presents several interesting features. It was built to the designs of Mr. Herbert Broadbent, M.I.E.E., electrical engineer to the Perth Gas Co., with the aid of local labour, only the raw material being imported in the shape of angle-iron, steel plate, &c. The building is of steel frame construction, as shown in the view on the preceding page. The concrete foundation having been laid, and the verticals erected, a heavy wooden balk was put up at one end of the site; the roof members were then built up on the ground, hauled up between the balk and the building, and slid along the top of the frame into position. The framework was afterwards covered with galvanised iron.

The steel chimney was built up on the ground, of steel plates bent to shape in a local forge, and riveted together. The foundation consisted of concrete and brickwork, upon which were provided iron lugs corresponding with lugs riveted to the base of the chimney. When ready, the chimney was rolled along into line with the foundation, jacked up to the right height, and hinged to the foundation by bolts passing through the four lugs. The timber balk used for erecting the roof of the building was then re-erected in line with the chimney, and securely guyed. The permanent stays were fixed to the chimney shaft, and additional heavy tackle was attached to it at points between half and two-thirds of its height. The chimney was then slowly hauled upright, care being taken to maintain equal tension on the tackles and to steady the chimney with guys. The operation of erection took 70 minutes. When upright, the chimney was firmly guyed in place, and the tackle removed. The dimensions of the shaft were 130 ft. high from the foundation, 7½ ft. diameter inside, and it was lined with firebrick to a height of 90 ft. The total weight was estimated at 22 tons. The upper plates were made to overlap the lower ones, so as to leave no ledges for the lodgment of water outside. The boiler, seen in the view, is of Messrs. Babcock & Wilcox's make, of 1,000 h.p. capacity, and there is a large water tank in the foreground.

Another view shows the first generating set, mentioned above, installed in the new station. It will be noticed that the dynamo is protected by a galvanised iron roof from falling moisture; this was necessitated by the tendency to sweat in the semi-tropical climate, resulting in the formation of drops of condensed moisture on the roof members. To exclude dust when the machine is standing idle, a roller-blind arrangement of screens has been fixed round the edges of the cover.

A second generating set, of similar capacity, consisting of a General Electric Co.'s dynamo coupled to a Willans engine, is on order, together with condensing plant for both sets. An additional boiler, and a number of minor additions, are also in hand.

At the older station, which continues in operation, a steel shaft has been erected in place of the original brick chimney, in a manner similar to that described above; but the presence of surrounding buildings greatly complicated the process, rendering it very difficult. A steel-frame cooling tower was also erected, to the designs of Mr. Broadbent; one of our views shows the structure, which was afterwards clothed with wood and fitted with baffle plates.

Coal is brought to the old station by rail, but the siding is on the opposite side of the road. To bring the coal into the station, an electric telpher system has been installed, consisting of a steel bearer wire and trolley, and two overhead power wires. The apparatus was supplied by Messrs. Siemens Bros. & Co., and is capable of carrying 1,000 lb., the round trip occupying 4 minutes, and the power consumed being 25 amperes at 220 volts.

Trolley Crossing Street on Telpher Line.

From the foregoing it will be gathered that in West Australia energy and resource, and ability to back them, are not wanting. We are indebted to Mr. H. Broadbent for the photographs from which the accompanying illustrations have been reproduced.

PEEBLES-LA COUR MOTOR CONVERTER INSTALLATION AT MANCHESTER.

Our readers are fairly familiar with the extraordinary popularity of the Peebles-La Cour motor converter as instanced by the many installations which have been carried out during the past year or two.

The special qualities of these machines and the novel points in their design were dealt with at some length in the Electrical Review of May 11th last, in connection with the 120-kw. units installed at Stoke Newington.

A much larger installation comprising three 500-kw. units has been running in regular service at the Dickinson Street sub-station of the Manchester Corporation for many months past, and as these machines were designed to meet exceptionally severe conditions, some particulars will be of interest. These machines are being worked in conjunction with the Stuart Street station, enabling the latter to supply energy to the central portion of the city.

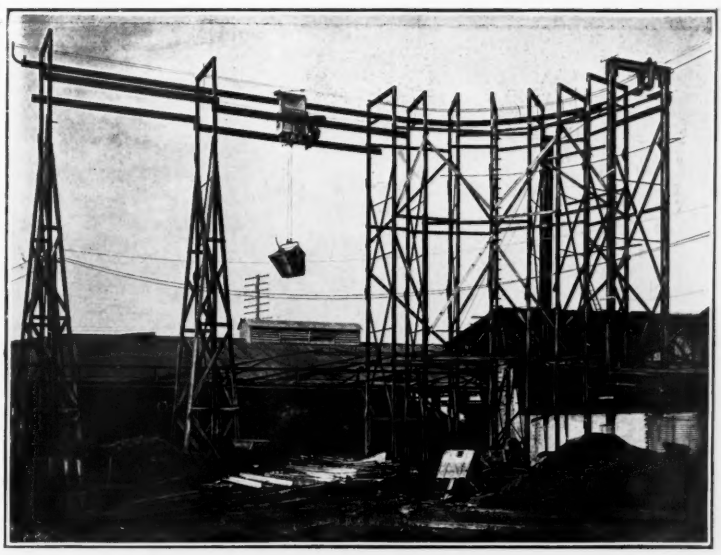
They are used for both lighting and traction work, necessitating a pressure variation of from 400 to 550 volts: the lighting pressure actually varies from 400 to 460 volts, averaging 435, and the traction pressure variation is from 500 to 550 volts, averaging 520.

Thus, extremely good pressure control was an essential feature, which discounted the use of the rotary, while, on the other hand, the motor-generator was also unsuitable on account of its lower efficiency at light loads as compared with the Peebles plant.

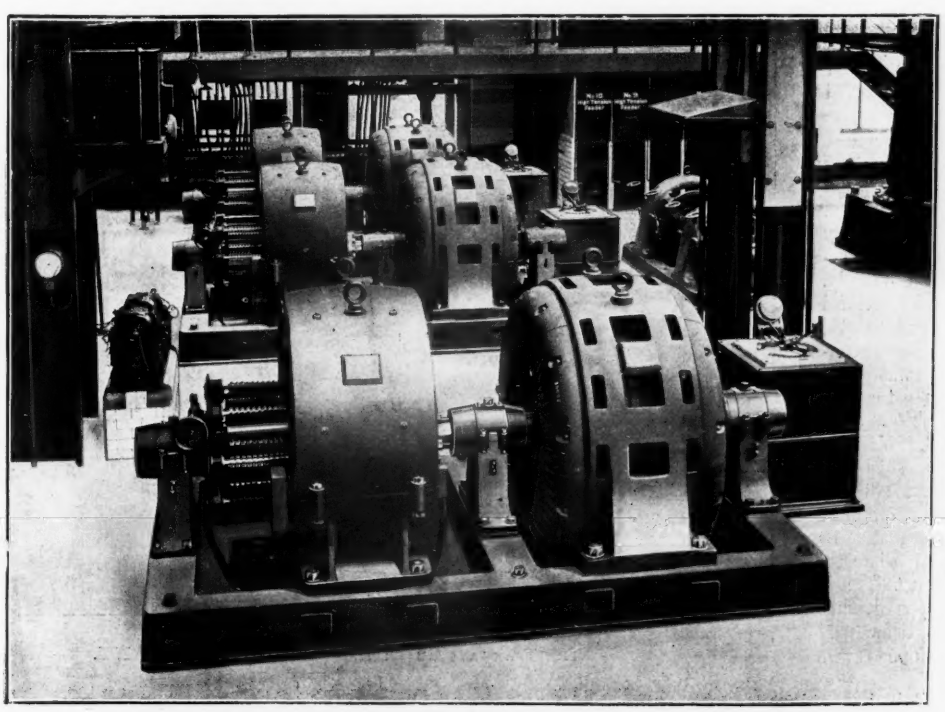
The Manchester machines, which we illustrate, consist on the alternating side of an ordinary induction motor, with a rotor wound for 12 phases. The stator core is of the distributed slotted type, 1,033·8 mm. inside diameter, with 72 semi-closed slots.

The 6,500-volt. h.t. winding is wound by hand in mica tubes capable of withstanding 30,000-volt pressure. The rotor core, 1,029·8 mm. outside diameter, and 325 mm. wide, is also of the distributed slotted type, with 90 semi-enclosed slots. The winding in the latter case is of the bar type, with presspahn and Empire cloth insulation.

The direct-current armature is 950 mm. in diameter, with 108 slots, and six coils in each. We understand that the official tests of these machines were in every way satisfactory, while it is anticipated that some further tests for the purpose of comparing the commercial efficiencies of the various sub-station equipments in use at Manchester, will prove the superiority of the motor-converter type of plant.



Perth, W.A., Electricity Works: Curve and Terminus of Telpher Line in Coal Siding.

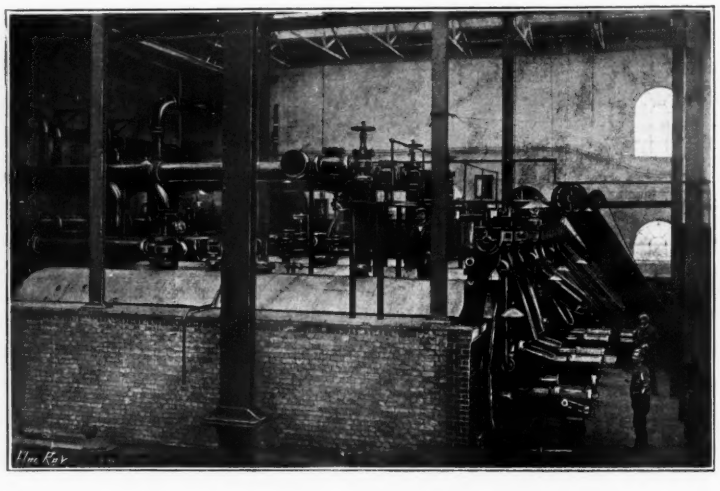


Peebles-La Cour Motor Converters at Dickinson Street Sub-station, Manchester.

To Messrs. Bruce Peebles & Co., to whom we are indebted for the accompanying illustration, we offer our congratulations on these very desirable results. We gather from the official reports of the Corporation, that many similar equipments are to be installed.

THE WELLINGTON (NEW ZEALAND) MUNICIPAL ELECTRIC TRAMWAYS.

In an article from the pen of Mr. F. C. Perkins, our esteemed contemporary the *Electrical Review* of New York, for August 18th, gives some interesting details of the Wellington Municipal Tramways. These, we gather, have a total length of 21½ miles, built to a gauge of 4-ft. The rails are of the British Standard section No. 2, weighing 95 lb. per yard, and are laid on a concrete bed.



The Boiler House Plant: Wellington (N.Z.) Tramways Power Station

No. 0000 stranded copper bonds are employed for track bonding. The overhead work is suspended from welded steel tubular poles, the latter being fitted with artistic bases and scroll work; the trolley wire is No. 0000 gauge of hard drawn copper, fixed with sweated ears and flexibly suspended.

In connection with the undertaking, a commodious power house has been erected on reclaimed land near the harbour and close to the new coal wharf which is being erected for the harbour board.

The site is fairly central for the tramways, and obviously, well situated in regard to coal and water facilities. Some consideration was required as to the type of chimney to be erected, Wellington being subjected to earthquakes; finally a brick chimney 130 ft. high and 10 ft. internal diameter was constructed, and this, it appears, has already satisfactorily weathered one severe test.

The buildings comprise engine, boiler and condenser houses, together with a feed pump room.

The boiler house, which measures 70 ft. × 81 ft., contains at present three Lancashire boilers, each 30 ft. long and 8 ft. diameter, built for a working pressure of 160 lb. per sq. in., and space is available for four extension boilers, two of which are on order.

A mechanical coal-handling plant has been installed; the coal, once tipped into the bunker, is fed by means of a series of motor-driven conveyers, made by the New Conveyer Co., into the hoppers of Erith mechanical stokers. These are of the underfeed type; the coal is forced in with a simple ram action below the fire line, and as the fresh coal rises it is brought to the coking stage at which the gases are liberated to pass upward through the fire. Forced draught is provided by means of motor-driven fans of the Cyclone Fan Co.'s manufacture, which maintain a high furnace temperature. Two Weir feed pumps, each with 7 in. dia. piston, 9½ in. cylinder, and 21 in. stroke, and with a capacity of 4,000 gallons per hour, are installed for boiler feeding. The feed water passes through a Green economiser of 640 tubes; the scrapers are electrically driven. An auxiliary by-pass flue is also provided as a standby during overhaul. There are two steam branches from each boiler, one leading direct to a 10-in. range, and the other to a Bolton superheater with a heating surface of 190 sq. ft., set at the rear end of each boiler.

The steam superheat is about 100° F. Geipel steam traps, placed in suitable positions, are provided for draining the steam range. Four engines of the Belliss & Morcom triple-expansion, high-speed, self-lubricating type, direct coupled to Electric Construction Co. six-pole direct current generators are installed in the engine room. One of these is of 250 H.P., and three of 500 H.P. each. The foundations are in place, however, for two additional machines, one of which, of 1,000 H.P. capacity, is on order.

For municipal lighting the small set is used, supplying energy at 220 volts pressure. This set is also used from midnight to morning as a traction unit for car-shed work,

The Tramways Generating Plant: Wellington, N.Z.

The speed of the small set is 500 R.P.M. and of the others 375 R.P.M.

The engine room is spanned by a 15-ton three-motor Jessop & Appleby crane.

The condensing plant is of the Korting ejector pattern, the use of which was, of course, facilitated by the plentiful supply of sea water at hand.

Three Gwynne centrifugal pumps are installed for lifting

condensing water from a large culvert to an overhead tank, from which it gravitates through the ejector condensers attached to each engine. An average vacuum of 27 in. is maintained.

It may be noted that the engine room walls have been sheathed with Wunderlich stamped steel facings, painted suitably, owing to the difficulty of following the usual practice of glazed tiling, &c.

The switchboard is situated on a gallery at one end of the building; it contains the following panels in blue-grey marble:—Four generator, one Board of Trade, one summation, and nine feeder panels with standard tramway switchgear and instruments.

A car-shed 384 ft. long and 101 ft. wide, is provided for housing the rolling stock; the shed contains extensive paint and repair shops, with an equipment of motor-driven tools.

The rolling stock consists of 46 cars of various types, including single and double deck, combination, side door and open-ended patterns, the majority of which are mounted on Brill trucks, and fitted with two 25-H.P. G.E. motors.

Westinghouse magnetic brakes, Bowring life-guards and Holmes-Allen trolley heads are other features of the equipment.

A great many extension schemes to the suburbs are proposed, and some are practically completed.

Messrs. Macartney, McElroy & Co. were contractors for the tramway construction, cars, &c., while the Electric Construction Co. carried out the power house work.

We are indebted to Mr. L. E. Davids, late of Wellington, N.Z., for the accompanying illustrations.

TRAMWAY and RAILWAY NOTES.

(*Concluded from page* 538.)

Oxford.—On the 26th ult. the City Council considered tenders for the electrification and reconstruction of the present horse tramways in the city. Two tenders were sent in; one by the National Electric Construction Co., which proposed to lay down the Dolter system, and the other by the Oxford Tramways Co., which gave conditionally the offer of three systems—the Lorain, the Griffiths-Beddell and the conduit. The members of the Corporation, it transpired, had visited Wolverhampton, Rawmarsh and Lincoln to see the systems at those places in operation. At Rawmarsh a trial trip on the Dolter system was arranged, the line not yet being open. Mr. Stephen Sellon was consulted by the Corporation, and reported in favour of the Oxford Co.'s offer, which he regarded generally as a sound business proposition, providing adequately for the needs of the city. In the course of a discussion on the tenders, several alleged inconsistencies were pointed out in Mr. Sellon's report, and it was strongly urged that the offer of the Dolter Co. was much more advantageous in the matter of the rental to be paid to the city and the guarantee. It was ultimately resolved, by 32 votes to 10, to accept the tender of the National Electric Construction Co., as, all things considered, it was the best, subject to the guarantees offered proving satisfactory, and also subject to an undertaking that, if the Dolter system did not prove satisfactory, the company would lay down another, and to such other modifications and provisions as might be required by the Corporation.

Paraguay.—The Government has decided to call for tenders for the installation of electric light and electric tramways in Asuncion.

Simplon Tunnel Railway.—The administration of the Swiss Federal Railways announces that with the exception of two periodical trains *de luxe*, no more trains hauled by steam locomotives will traverse the Tunnel. During the third week in September 116 electric trains, four mixed trains and 12 steam trains passed through the Tunnel. The time occupied by the electrically-hauled trains in journeying between Brieg and Iselle is 20½ minutes, while in the opposite direction the time increases to 29½ minutes. It is stated that experts and officials declare the electric service satisfactory and reliable.

Teddington.—A driver in the employ of the L.U.T. Co. was, at Feltham a few day ago, summoned for driving a tramcar at Teddington, at a speed of 16 M.P.H., contrary to the regulations, and a fine of 10s. was imposed.

Walthamstow.—The Board of Trade has confirmed the Order for the Tottenham and Walthamstow Light Railways. The Great Eastern Railway Co. is to be asked when it proposes to proceed with the widening of Ferry Lane Bridge, as until this is done it is impossible to proceed with the construction of the light railway.

Wimbledon.—In regard to the question of at once putting the remaining sections of the authorised tramway scheme in hand, a *Times* correspondent says that the L.U.T. Co. has been actively negotiating with the owners and occupiers of the hundreds of properties affected, the scheme entailing an expenditure of over £200,000 on public improvements in Wimbledon alone. Contracts for the construction of the additional lines have now been placed with Messrs. Mowlem & Co., for the permanent way and overhead work, and with Messrs. Henley, for the cables, the company itself undertaking the works of public improvement. It is hoped that the whole of the lines will be in operation by May 1st next, even if the Wimbledon Town Council does not regard the commencement of operations as a guarantee of the company's good faith sufficient to justify an immediate withdrawal of its embargo upon the use of the line already completed. Notices have been served of the contractors' intention to break ground on Monday, October 8th, and the Town Council will have an early opportunity of considering the new situation.

United States.—NEW YORK.—On Monday last the first electrically-hauled train passed over the New York Central lines into the city with successful results. The train consisted of eight Pullman cars, weighing 550 tons, and started from a point seven miles from New York. The company has 35 electric locomotives, each weighing 100 tons, of the type described in our issue of October 27th last year.

TELEGRAPH and TELEPHONE NOTES.

Iceland.—The Great Northern Telegraph Co. announced on Saturday last that the line in Iceland from Seydisfjord to Akureyri and Reykjavik would be opened for traffic that afternoon. The rate from any office in the United Kingdom is 8½d. per word.

Post Office Telephone Directory.—Following the lead of the National Telephone Co. and the *Westminster Gazette*, the names of new subscribers to the Post Office Telephone Service are being published in the *Tribune* and the *Standard* on Mondays, together with other new information relating to the service.

Post Office Telephone Service.—A number of complaints have been formulated of late against the service provided by the Post Office system, such as overcharges for messages, delay in answering calls, &c. Where large numbers of subscribers are concerned, such troubles must always occur. Our own experience has been that delay in answering calls on the part of the exchange operators is very usual in the case of both the Post Office service and the National Exchange.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Tarifa-Tangier	Jan. 18, 1904	
Garachico (Tenerif)-Santa Cruz	July 12, 1906	
Bolamo-Bissao	July 24, 1906	
Curacao-La Guayra } Closed. Curacao-Coro }	Jan. 11, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Las Palmas-Grand Canary	Sept. 18, 1906	
Arecife-Las Palmas	Sept. 18, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Bachkale-Deliman	Feb. 12, 1906	
Bagdad-Bassorah	July 17, 1906	
Via Fao-Hanekin and El Arich	Sept. 27, 1906	Sept. 27

Telephone Trunk Line Rates.—In order to encourage the use of the trunk telephone wires at night, the Postmaster-General has decided that, on and from October 1st next, the charge for three minutes' trunk wire conversation between the hours of 7 p.m. and 7 a.m. is to be half the day rate, except in the case of calls for which the ordinary day charge for three minutes' conversation is 3d., 6d., or 9d. In the case of those calls, however, a double period of time will be allowed.

United States.—On account of the great storm at Pensacola, the *Daily Telegraph* correspondent at New York states that "news is still very meagre, for telegraphic communication is chaotic."

Wireless Telegraphy.—It is reported from Copenhagen that a Danish engineer, Valdemar Poulsen, who exhibited his "telegraphone" at the Paris Exhibition of 1900, has completed a new invention in connection with wireless telegraphy, of which a demonstration was recently given. The invention is claimed to be an entirely new system of wireless telegraphy, in which, by means of a simple contrivance, each transmitting apparatus is tuned for the dispatch of any desired frequency, and only that particular receiving apparatus which harmonises with it is able to receive the message. The person transmitting has, therefore, only to look at a list which shows him how to set his apparatus so as to be able to enter into communication with any one station or another. In the case of the recent experiments M. Poulsen established one of his testing stations in a wooded district not far from Copenhagen, while the second was erected at Esbjerg,

on the North Sea coast. The "tunes," as the inventor terms them, were, therefore, sent over land and sea alternately, and the experiments are described as having been highly successful. Count Arco wished to purchase the invention, but M. Poulsen is reported to have disposed of it to the Armstrong de Forest Co. for £30,000 in cash and a number of shares in the company, while the inventor will receive £1,000 per annum for a period of five years for handing over any improvements which he may make during that term.

An extraordinary development of wireless telegraphy in Germany and between that country and others is now taking place. On September 20th a telegram was received in Berlin from St. Petersburg, announcing that great satisfaction was manifested in the latter city with the results of the experiments with wireless telegraphy according to the Popoff-Telefunken system, as undertaken between St. Petersburg and Nauen, near Berlin. In connection with this matter, it was stated on the following day, apparently on behalf of the Berlin Co. for Wireless Telegraphy, that tests on a small scale were begun a few weeks ago at the large station which has been erected at Nauen. At first a connection was established with a warship in Kiel Harbour, and then communication was effected with the lofty station which has been built at Norddeich, on the coastline of the North Sea. This was followed by an interchange of telegrams with the station at Scheveningen, and then the trials were gradually again extended. It happened in this way that telegrams dispatched one morning to Norddeich were answered about midday from Rigi-Scheidegg, where the Swiss military authorities have constructed a "telefunken" station, as was mentioned in these columns a few weeks ago. The answer was:—"Telegrams very strongly received. Who sent them?" In this manner communication was opened with Switzerland unintentionally. Confirmation of the reception of wireless messages also arrived from other directions, including the Technical High School at Darmstadt. At the middle of September the trials were resumed on a larger scale. It was desired, in the first instance, to place Nauen in connection with the station at St. Petersburg, a distance of about 868 miles measured in a straight line. The apparatus in Russia is arranged according to the Popoff-Telefunken system, which is so named in memory of the deceased Prof. Popoff, although the method shows only slight variations from the German principle. On Tuesday morning (September 18th), between 5 and 7 o'clock, wireless messages were forwarded from Nauen to the Polkowopole Station, near St. Petersburg. In the afternoon the answer arrived that the telegrams had been received well, and the experiments are now being continued between the two capitals. The next scheme of the Berlin Co. is to open up communication with the northern coast of Africa, where a station has been built at Derna, in Tripoli, for the Turkish postal authorities, while a second station is to be found at Patara, in Asia Minor, opposite the island of Rhodos. These stations are each arranged on wooden towers 200 ft. high, and are both in working order at the present time.

As previously stated, the De Forest Co. is erecting a wireless station at Whitley Bay, which will shortly be ready for work. It is unfortunate for the company that references to the station in a provincial paper should describe it as a "Marconi station."

The Institute of International Law concluded its labours at Ghent on September 29th. It was decided to hold the next session at Florence in 1908. The following is the text of the additional articles adopted by the Institute with reference to the use of wireless telegraphy in time of war:—

Article V.—The regulations in force in time of peace are not applicable in time of war.

Article VI.—On the high sea, in the zone covered by the sphere of action of their military operations, belligerents may prevent the dispatch of Hertzian waves by a neutral State.

Article VII.—Individuals who, in spite of the prohibition of the belligerents, engage in the transmission of messages by wireless telegraphy between different sections of a belligerent army or territory, are, if captured, to be considered as prisoners of war, and treated as such. Ships and balloons belonging to neutrals which, by movements in concert with the enemy, may be considered as being engaged in his service, may be confiscated, as well as the dispatches and wireless telegraphic apparatus found on them.

Article VIII.—A neutral State is not obliged to prevent the passage over its territory of Hertzian waves destined for a belligerent State.

Article IX.—A neutral State is obliged to close, or take under its own administration, any radiographic establishment belonging to a belligerent State which it had authorised to operate within its territory.

Article X.—Every prohibition of communication by wireless telegraphy issued by belligerents must be immediately notified by them to neutral Governments.

Wireless Telegraphy Conference.—At the international conference on wireless telegraphy, which opened on Wednesday, all the maritime States of the world are represented except China, Peru and Turkey. The British delegates are Mr. H. Babington Smith, C.B., Secretary to the Post Office; Mr. J. Gavey, C.B., Engineer-in-Chief to the Post Office; Mr. R. J. Mackay, of the Post Office; Captain the Hon. A. E. Bethell, Assistant Director of Naval Ordnance; Colonel J. F. Daniell, Assistant Director of Naval Intelligence; Lieutenant J. G. Loring, R.N.; Colonel R. L. Hippisley; and Colonel F. J. Davies, Assistant Director of Military Operations. Egypt is represented by Major J. S. Liddell, Inspector-General of the Telegraphs Administration. The sittings of the conference will probably extend over several weeks.

CONTRACTS OPEN and CLOSED.

OPEN.

Austria.—October 6th. The Austrian State Railway authorities in Vienna are inviting tenders for an installation of electric lighting in the railway wagon works at Knittelfeld.

Austria.—The municipal authorities of Szaszregen (Siebenburgen) are about to invite tenders for the establishment of a central electric lighting station in the town.

Beckenham.—October 29th. Induced draught apparatus for the U.D.C. electricity and destructor works. See "Official Notices" to-day.

Dundee.—October 13th. Small coal for the electricity department. H. Richardson, city electrical and tramway engineer.

Hungary.—November 15th. The municipal authorities of Veszprem are inviting tenders for the establishment of a central electric lighting station in the town.

Johannesburg.—October 15th. Tenders are required by the T.C. for single-phase A.C. motors with accessories. See "Official Notices" August 31st.

Manchester.—October 31st. One 5,000-KW. turbo-alternator complete with condensing plant, for the Corporation. See "Official Notices" to-day.

Metropolitan Railway.—October 8th. The directors want tenders for stores for one year. Some of the items are:—

No. 17.—Electric lamps, carbons, fuses, ebonite, &c.
No. 18.—Electric wires and cables.
Nos. 27 and 28.—India-rubber goods.
No. 42.—Signal iron-work, wire pulleys, switch-boxes, &c.
No. 44.—Telegraph fittings, battery jars, zincs, insulators, &c.

Particulars and forms from the Storekeeper, adjoining Neasden Station, N.W., between October 1st and 6th.

Newport (Mon.).—October 13th. Feeder boosters, balancer, electrically-driven pumps, switchboards and instruments, for the Corporation. See "Official Notices" September 28th.

Spain.—October 15th. The municipal authorities of Cadalso (Province of Madrid) are inviting tenders for the concession for the electric lighting of the town. Tenders are to be sent to El Secretario del Ayuntamiento de Cadalso (Madrid), whence particulars may be obtained.

Walthamstow.—Tenders are to be invited for a small water-tube boiler.

CLOSED.

Bexley.—The U.D.C. has accepted the following tenders:

Friday & Ling.—Erection of car-sheds.
Measures Bros., Ltd.—Steel-work for car-sheds.
C. P. Kinnell & Co., Ltd.—Heating car-sheds.

Bradford.—The contract for the electric light installation and switchboard for Messrs. James Lee & Sons, Ltd., the Tannery, Hipperholme, Yorkshire, has been secured by the Bradford Electrical Engineering Co.

Bristol.—Messrs. Meldrum Bros., Ltd., Timperley, have received an important order for their "Koker" stokers combined with the Meldrum system of air supply for four Babcock & Wilcox marine boilers at the Avonbank Electricity Station of the Bristol Corporation. Each boiler will have a grate 19 ft. 6 in. in width, and the four are to evaporate 140,000 lb. of water per hour. The existing 12 boilers at the same generating station are equipped with the Meldrum stokers and the success of these has led to their adoption for the new boilers.

Brush Contracts.—The following contracts have recently been booked by the Brush Electrical Engineering Co., Ltd.:—

For the North British Railway Co.—21 corridor first-class carriages and bogies; eight non-corridor ditto.
For Jammu (India).—Complete lighting and pumping installation, consisting of water-turbine driven alternators, transmission line, motors, pumps, &c.
For Chatham (per B.T.-H. Co.).—Five double-deck car-bodies and trucks.
For the Nottingham Corporation.—Ten car-bodies with top-covers, mounted on trucks.
For Burton-on-Trent.—Three car top-deck covers.

Dartford.—A contract for feeder, pilot and distributor cable, together with feeder pillar, boxes and fittings, has been placed with Messrs. Johnson & Phillips, Ltd., by the U.D.C.

Derby.—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of a Tirrill regulator, at £63 7s. 6d., and the rewinding of four armatures, at £55 10s., and that of the British Electric Transformer Co. for a transformer, at £35 and the old transformer.

Dudley.—The Tramway Committee of the T.C. has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply of distributing cables.

France.—La Compagnie Française pour l'Exploitation des Procédés Thomson-Houston has secured a contract from the Société L'Energie Electrique du Littoral Mediterranean for the establishment of a large electricity generating station at La Brillane, in the Lower Alps.

Gloucester.—The T.C. has accepted the following tenders for 15 months' supplies to the tramways:—

Alger & Blackmore.—Twist drills, bolts and nuts, screws, &c.
L. Andrews & Co.—Oil tape, ebonite and red fibre sheet.
Callender's Cable Co.—Cables.
Crypselco, Ltd.—Lamps.
Conway, Jones & Co.—Paints, oils, &c.
J. L. Duguid & Co.—Metal polish.
Glacier Anti-Friction Metal Co.—Anti-friction metal.
Henley's Telegraph Works Co.—Para strip.
Hadfield's Steel Foundry, Ltd.—Tires.
Johnson & Phillips.—Grey dynamo tape, superfine tape, micanite plate.
Jones & Son.—Sulphur and paraffin wax.
London Electric Wire Co.—Presspahn.
T. B. Powell.—Light car oil.
C. D. Phillips.—Iron, brass and gun-metal castings, brake blocks.
Ruberoid Co.—P. and B. insulating tape and electrical compound.
Clifford Stanley.—Screws, cotter pins and hack saw blades.
H. E. Thorne.—Washers and nuts.

Halifax.—The T.C. on Wednesday accepted tenders of the British Insulated and Helsby Cables, Ltd., for feeder cables.

London.—Hackney.—Last week we reported at length the E.L. Committee's recommendations *re* street lighting tenders. We understand that the B.C. on Thursday, September 27th, out of 86 tenders submitted, accepted the following, which were those marked "recommended" in our last week's issue:—

Section A.—Arc lamps and pillars.—W. Lucy & Co., Oxford.—£1,174.
Section B.—Erection and painting of arc lamp pillars and switch pillars.—W. Lucy & Co., Oxford.—£479.
Section C.—Flame arc lamps and accessories.—General Electric Co., Queen Victoria Street.—£1,808.
Section D.—Nine switch pillars and accessories.—Cable Accessories Co., Tipton.—£164.

Messrs. Robert Hammond & Son are the Council's consulting engineers.

St. Pancras.—We are asked to state that the order recently placed by the St. Pancras B.C. with Bruce Peebles & Co., Ltd., covers two 500-kw. and one 1,000-kw. Peebles-La Cour *motor-converters*, and not *motor-generators*, as previously announced.

Manchester.—A tender of the United Electric Car Co., Ltd., Preston, for the supply of 20 combination tramcar bodies has been accepted by the Tramways Committee.

Stoke-on-Trent.—The T.C. has accepted the tender of Babcock & Wilcox, Ltd., for a water-tube boiler for the electricity works, at £1,330, and that of Callender's Cable & Construction Co., Ltd., for 1,370 yards of ·2 sq. in. single vulcanised bitumen cable, at £250.

Sunderland.—Messrs. Davidson & Co., Ltd., Belfast, have received an order from the Corporation for a "Sirocco" induced draught fan, direct coupled to a motor. The fan, which is 60 in. diameter, is to be a duplicate of the "Sirocco" fan already in operation in the Sunderland Electricity Works.

The Irish Exhibition.—Messrs. D. Santoni & Co. (1906), Ltd., have secured the contract for the exclusive supply of their Flame lamps to the Irish International Exhibition, to be held in Dublin from March 1st, 1907, to November, 1907.

Walthamstow.—The U.D.C. has accepted the following tenders:—

British Electric Equipment Co.—Alterations and additions to permanent way of the light railways.
Chamberlain & Hookham, Ltd.—Annual supply of meters.
W. T. Glover & Co.—Fire-proof cables.

An order has been given the Tudor Accumulator Co. to renew the positive plates of the storage battery at the Sanatorium.

West Ham.—The B.G. has accepted the tender of Messrs. Pryke & Palmer for the supply of light E.L. wire, at £10 10s. per mile. Johnson & Phillips, Ltd., tendered, at £32 10s.; Troupe, Curtis & Co., at £15; and Neville & Co., at £23. The tender of Troupe, Curtis & Co. for contact hinges, at 1s. per dozen, was accepted, and that of Pryke & Palmer for receiver cords, at 2s. per dozen.

Wimbledon.—The T.C. has accepted, at £125, the tender of G. & J. Weir, Ltd., for a steam feed pump for the boiler house at the generating station.

York.—The Electricity Committee of the T.C. has accepted the tender of the Pulsometer Engineering Co., Ltd., Reading, for the supply of a water-softening and filtering apparatus.

FORTHCOMING EVENTS.

To-day's Events.—At 8 p.m. Electro-Harmonic Society. First smoking concert of the season at Holborn Restaurant.

Open to October 17th.—Engineering and Machinery Exhibition at Olympia, Kensington, W.
Saturday, October 6th.—At 3 p.m. Association of Engineers-in-Charge. Visit to the New Central Criminal Court.
Wednesday, October 10th.—At 7 p.m. Dynamicables' dinner at Olympia.
Saturday, October 13th.—At 3.30 p.m. Junior Institution of Engineers. Visit to the Engineering and Machinery Exhibition at Olympia.
At 7.30 p.m. Birmingham and District Electric Club. At Colonnade Hotel, New Street. Mr. W. Langdon-Davies and Mr. F. B. O. Hawes on "Some Points about Single-phase Motors."

NOTES.

Action of X-Rays.—We regret to learn, from a letter in the *British Medical Journal*, quoted by the *Daily Telegraph*, that Mr. J. Hall-Edwards, President of the British Electro-Therapeutic Society, has for two years suffered extremely from X-ray dermatitis, which has caused the eruption of numerous very painful warts on the backs of his hands—no fewer than 50 or 60 on each hand. The pain is excruciating and incessant, and the sufferer urges all engaged in X-ray work to protect themselves before it is too late. On the other hand, Prof. Imbert, of Montpellier, has experienced a remarkable rejuvenation in appearance through exposure to the influence of X-rays, his hair and beard, which had long lost their colour, having been restored to their pristine beauty!

Electric Shock Fatality.—As we mentioned briefly in our last issue, an inquest was held at Derby on Wednesday, September 26th, into the death of Thomas William Allsopp, aged 21, a journeyman butcher, who was killed on the previous Thursday through coming in contact with a switch connected with an electric fan in a cooling room on the premises of Mr. W. Cope, pork butcher, King Street, Derby, by whom he was employed. The town clerk (Mr. G. Trevelyan Lee) appeared for the Derby Corporation, and Mr. Gilbert Scott Ram attended on behalf of the Home Office, whilst Mr. Sydney Smith, the Government inspector for the district, was also present.

Allsopp's father gave evidence that deceased was strong and healthy, and had not suffered from heart or any other disease.

Evidence was given to the effect that two electric fans were fixed in the cellar last June, and that the installation, upon examination, was found to be sound, the test being described as extraordinarily good. It was tested to 500 volts in the first instance, but the voltage was only 200. The deceased had been in the habit of turning on the switch, and there had not been any shock prior to this accident, nor had any leakage been noticed. The cellar was damp, and brine was used for pickling pork, and it was proved that this would contribute to the creation of a leakage. The medical evidence showed that the deceased was a strong, muscular man, and that all the organs were sound. Death was due to sudden failure of the heart consequent upon an electric shock.

Mr. T. P. Wilmshurst, chief electrical engineer to the Derby Corporation, deposed that he examined the fans after the accident, and when testing the one grasped by the deceased, he experienced a distinct shock of varying intensity, according to the position of the switch handle. The fan was in perfect order except for this leakage, and this, in his opinion, was due to the action of brine which had been spilt or splashed on the fan and permeated the working parts of it.

The Coroner: Considering that and also that the deceased's boots and hands were damp, would that have a tendency to create a current through the body of the deceased, although the voltage was only 200?

Witness: Up to the time of the accident, I should have said that the circumstances were not sufficient to cause death. He had never heard of a similar cause of death under 200 volts, except under exceptional conditions of dampness. The fact that the deceased was standing in a puddle and that his hands and the fan were permeated with brine would be sufficient to cause death. The presence of salt in the water gave an increasing conducting power to the water and the man's skin. There were thousands of similar fans in the country, and there were no regulations requiring special protection below 250 volts, which was the regulation low pressure. In view of this accident, he should recommend certain precautions, but there was considerable difficulty in earthing these fans, as they were portable.

In answer to Mr. Ram, Witness said they generated at 2,000 volts at the station, but he had tested the machinery and found that there was no possibility of the high pressure getting on the low pressure circuits.

Mr. J. F. C. Snell said he had made a careful examination of the premises and fan, and he found that the fatality was due to a coincidence of five causes:—First, the condition of the unfortunate victim's hands, which were probably saturated with brine; second, his boots were probably, and evidence had shown that they were, saturated with brine; third, the wet condition of the cellar; fourth, the wetness between the switch handle and the casing of the fan; and, fifth, the fact that the deceased grasped the standard instead of the switch, and was unable to let go. Prior to this accident he would never have suggested that these fans should be earthed, but in the light of that fatality he would alter his mind.

Mr. Gilbert Scott Ram agreed with Mr. Wilmshurst and Mr. Snell that 200 volts was looked upon as quite safe, but that case was by no means an isolated one. It was quite unnecessary to have brine as a contributory cause, and the accident might have occurred without the presence of brine or water. In a damp cellar such as this certain precaution should be taken, but accidents so seldom occurred with portable fittings that they were not generally known.

The jury returned a verdict of "Accidental death," and added a rider to the effect that the Corporation, Mr. E. Haslam (who fitted in the installation) and Mr. Cope were entirely free from blame and responsibility. They also recommended that the conditions surrounding portable fans and other electric installations should be very carefully considered, and the necessary precautions or warnings issued to those about to use them.

Labour Troubles.—Engineering seems to be on the verge of a series of labour conflicts which promise certain disaster both to our national manufacturing industries and to the vast bodies of men who are dependent upon them for their means of subsistence. In one part of the country trade union tyranny is asserting itself in demanding the dismissal of non-union men, while in other parts demands for higher wages have been pressed in utter indifference to the fact whether the profits are sufficient to allow of their being conceded by employers. Among workmen engaged in the shipbuilding industry of the Clyde, the coal-mining industry in South Wales and certain parts of Scotland, the north-east coast engineering employés, and the coach-builders employed by the Brush Electrical Engineering Co., Ltd., at Loughborough, there is the same disaffection. Where it will stop no one can yet say, it may reach far uglier proportions, but the doings of the last Parliamentary Session have helped to set loose among us a more militant and more discontented labour spirit which, if it be impossible to direct or lead it, will have to be broken unless our position as a manufacturing nation is to be permanently sacrificed at the shrine of Socialism. It is becoming more and more difficult for our manufacturers to make profits in view of the severity of competition—home and foreign—and if working expenses be still further increased by the payment of higher wages, there must be a reduction of even the present low margin of profit, leading to perhaps a loss. The working man does not yet seem to realise that, generally speaking, no profit must mean no work for him.

There are 7,000 boiler-makers on strike on the Clyde, and 3,000 labourers have been thrown out in consequence.

30,000 miners in the South Wales coalfields have handed in their notices.

Engineers at Stockton-on-Tees, Newcastle and Darlington may hand in their notices shortly because the employers have refused to grant an advance of 2s. per week on time rates and 5 per cent. on piece work.

Manchester engineers have made applications for similar advance.

The Scottish miners (70,000) had demanded an increase of 12½ per cent. in wages.

Adding to these the strike of 160 coach-builders at the Brush Co.'s Loughborough works, and bearing in mind also the recent and still expected tramway workers' strikes, as well as the feared trouble among railway workers, there is sufficient cause for disquietude.

The disagreement at the Brush Works is a revelation of the tactics which are being adopted by the organisation of these 160 men. The managing director of the company (Mr. W. L. Madgen) and the manager (Mr. J. J. Steinitz) on Tuesday met the president of the United Society of Coach-builders and representatives of the strikers, and a detailed report of the proceedings appeared in the *Times* on Tuesday. The society's claim is that the Brush Co., being in competition with other firms, notably the United Car Co., should pay the same minimum rates of weekly wages as were paid by that firm at Preston. The rates of wages paid by the Brush Co. varied considerably. Therefore the men requested that there should be minimum standard rates of wages fixed. These were 34s. a week for painters and 36s. a week for body-makers. It was said on behalf of the firm that some of the men were inefficient, and consequently were not worth those rates. But, said the Union spokesman, inefficient men could not be allowed to drag down skilled men. The firm had their remedy; they could get rid of the inefficient men. Mr. Steinitz said that when he first saw the deputation on behalf of the men, he told them he proposed to follow the advice of their president, Mr. Kinggate, and put them on piece-work at increased rates, and that if they did not earn 47s. a week he would discharge them. That, he thought, was a fair proposal. The only answer he got to it was that the men left the works. His contention all along was—if the men thought they were worth a certain sum let them prove they could earn it; and if they proved they could earn it the company, of course, would pay it. Mr. W. L. Madgen made a lengthy statement expressing the views of the company, and he showed, among other things, that the demand that at Loughborough they should pay the same rate of wages as was alleged to be paid in other districts not comparable with Loughborough was unreasonable. It was shown that corporations in other towns had had pressure brought to bear upon them by reason of the present troubles to prevent contracts being placed with the Brush Co. At Sheffield, it was said, the placing of a contract with the Brush Co. depended upon the result of the deliberations being favourable to the men. The men's spokesman described Mr. Madgen's address as a "tissue of falsehoods," said it was "ridiculous" to call them there to hear it, and so on. It is not surprising, therefore, that no agreement was arrived at.

Our trades are so interdependent that there cannot be a cessation of work in one line of industry without others being affected. This point was well brought out at the conclusion of a leading article in the *Times* on Tuesday, in dealing with the strike of Clyde boilermakers. We quote:—"The strikers will probably find that some masters are rather pleased than displeased to be relieved of the necessity for competing for work at low prices, just to keep their yards going and their men employed. Others, with ships in hand which the buyers are in no great need of, will regard the situation with equanimity. Orders which are really pressing will, of course, go elsewhere, and, when it pleases the strikers to return to work, they may find that the work is in no hurry to present itself. . . . . Great numbers of innocent people are likely to be very injuriously affected by the strike. Hulls and boilers are the raw material which other industries work upon, and, when the production of these things is stopped, all the other industries languish. The engineering shops will suffer very promptly. People will not lock up capital in engines for non-existent ships especially in days of ceaseless change. In the shipyards themselves hosts of auxiliary workmen will be thrown out of employment—shipwrights, carpenters, joiners, brass-founders, painters and so on. Then, if we go backwards, we find the same thing. Less iron will be bought if ships are not being constructed, and, if less iron is wanted, less coal will be called for. Hence there will probably be depression in the Scotch iron and coal trades, which, in turn, have their subsidiary industries, all of which will be adversely affected. All this far-reaching mischief to working men and their families is wrought by a trade union, which chooses a falling market and the approach of winter for its interference with the delicate mechanism of national industry."

In the *National Review* for October, Prof. A. V. Dicey has an important criticism of the Trades Disputes Bill, 1906. His arguments are briefly summarised thus:—

1. "The Trade Disputes Bill will provoke a series of free fights between masters and men, carried on on both sides with energy, which will be unscrupulous, because it has been released from legal restraint."

2. "The Bill sacrifices to the supposed wishes of trade unionists the freedom of any person or class unable to resist extreme moral pressure, degenerating sometimes into illegal violence," and including "the exposure of working women to gross oppression."

3. "The passing of the Trades Disputes Bill will in the long run—and it may be a very short time—render morally impossible the suppression of boycotting, and, therefore, the maintenance of legal order in Ireland."

4. "The Bill corrupts the English democracy."

Institution and Lecture Notes.—Tramways and Light Railways Association.—The Official Circular for last month contains the report of the Joint Sub-committee, formed from the three Tramway Associations, and recommending amalgamation. This was submitted to the conference of the Municipal Tramways Association in London last year and was referred back. This year it was again brought forward at Leeds, and, as already reported in the Electrical Review, it was deemed inadvisable to proceed further in the matter. In both instances the Executive Committee of the Municipal Association expressed themselves unanimously in favour of the report drawn up by their delegates and those of the Association of Tramway and Light Railway Officials and of the parent society.

Engineering and Machinery Exhibition at Olympia.—On Saturday last a paper by the Hon. C. A. Parsons and Mr. R. J. Walker, on "The Development of the Steam Turbine," was read on the occasion of the visit of members of the Institute of Marine Engineers. The paper dealt mainly with marine propulsion, and it was stated that Parsons marine steam turbines of over 870,000 I.H.P. were completed or on order.

British Motor-Boat Club.—The first paper of the winter season will be read before the members of this club at the Craven Hotel, Charing Cross, on Thursday, 18th inst., by Lieut. Markham, the subject being "Horse-power—What it is—How it is Measured."

In the Library Hall, Church Street, Stoke Newington, to-morrow night, Alderman W. H. Savery, J.P., the Mayor, will lecture on "Electricity: How Made and Stored."

Mr. W. A. Tookey will, during the coming winter, deliver a series of lectures on "Gas and Oil Engines." The first course will be entitled "The Working Principles of Gas and Oil Engines," and will be delivered between October 22nd and December 12th; the second series will relate to "The Gas Engine Indicator and Indicator Diagrams," and will commence on January 21st, ending March 13th. During these periods the same lectures will be delivered twice per week, on Mondays at the Lecture Hall of the Gas Light and Coke Co., at Hackney; and on Wednesdays at the Lecture Hall of the South Metropolitan Gas Co., at Vauxhall Bridge, S.W.

Dr. R. S. Hutton lectured on "The Electric Furnace and its Applications to the Metallurgy of Iron and Steel" at the opening of the winter session of the Sheffield Society of Engineers and Metallurgists.

Dick, Kerr Engineering Society.—The 1906-7 session of the above society was very successfully opened by the second annual smoking concert, held at the Bull and Royal Hotel, Preston, last Friday evening. Mr. Cox, chief of the testing department, was in the chair.

Appointments Vacant.—Third electrical engineer for the St. John Del Rey Mining Co., Ltd., for Brazil, on a two or three years' engagement (£23 to £25 per month); shift engineer for Erith electricity works (£104). See our "Official Notices" to-day.

Switzerland.—The Schweizerische Elektrotechnische Verein held its annual meeting in Berne on the 23rd ult.

A Johannesburg Dance.—The first dance given by the members of the Electrical Trades Society was lately held in the Freemasons' Hall, in Jeppe Street. The society was formed last November, and now has a membership of 350. Two hundred couples were present at the dance, which was under the patronage of Mr. J. W. Quinn, Mayor of Johannesburg, and Mrs. Quinn, though they were not able to be present. The dance committee was as follows:—Mr. I. Cash (president), Mr. J. H. Cork (vice-president), Messrs. P. G. Fisher, G. Cox, and C. E. Seward (hon. secretary), and S. Blythe (treasurer). Masters of ceremonies were Messrs. I. Cash, J. H. Cork, C. E. Seward, F. Wishart, T. F. Smythe, and J. Nava.

Milan Exhibition Awards.—The *Standard* correspondent at Milan gives a list of the awards made to British exhibitors. This includes the following electrical or allied firms:—

The Grands Prix in their respective sections to:—J. F. Hopkinson & Co.; Elliott Bros.; Worthington Pump Co.; Sir William G. Armstrong, Whitworth & Co.; Cambridge Scientific Instruments Co.; Babcock & Wilcox; John Brown & Co.; Chadburn's (Ship) Telegraph Co: Willans & Robinson; British Electric Transformer Co.; Doulton & Co.

The Diplomes d'Honneur (the award next to Grand Prix, and above gold medal) have been won by:—Greenwood & Batley, Armorduct Manufacturing Co., Glenboig Union Fire Clay Co., A. P. Lundberg & Sons, Nalder Bros. & Thompson, Hele-Shaw Patent Clutch Co., Cape Asbestos Co. (South Africa).

The Hon. C. A. Parsons has been awarded one of the special gold medals given by the Milan Chamber of Commerce.

Diplomas of Bon Merite have been awarded to the National Electrical Manufacturers' Association and the Institution of Civil Engineers.

Johnson & Phillips, Ltd.—Messrs. Johnson and Phillips, Ltd., have started a motor-van department, and will specialise in the construction of delivery vans suitable for railway and other work. Mr. W. Hemingway, who resigned the position of chief draughtsman of the Daimler Co., in 1902, has joined the firm, and will be responsible for the new design.

We understand that the following tenders have been accepted by the firm:—

Additions to V.I.R. department at their works, Kirk & Randall, £6,000.

New paper-insulated lead-covered cable factory, G. Bollom, £8,500.

New machine shop, Redpath, Brown & Co., £3,200 (steel work only).

Suction Gas Power.—The following comes to hand as we go to press:—

"The singular fatality that attends the majority of suction gas calculations appears to have befallen the able letter of your correspondent, Mr. R. Weaving, of Peterborough. The cost per unit as produced by a suction gas plant is given by him as ·97d. Now a unit equals 1⅓ H.P.-hours approximately, How, then, does Mr. Weaving arrive at the figure of 2·9d. as the cost of 20 B.H.P. for one hour?

"Is this another clerical error?—The Writer of the Article."

Canal Commission.—Evidence was given at Dublin this week before the Royal Commission on Canals and Waterways. Mr. Henry Egan, chairman of the County Council of King's County, referred to the slowness of the traffic and the insufficient supply of water on the Grand Canal. In his opinion an electric motor system might be applied with advantage. Mr. James P. Macguire, Roscommon County Council, said that, in his opinion, the Royal Canal should be improved and deepened, and taken over by the State to be developed for the general good of the country.

Mr. J. G. Griffin, engineer and manager of the Swindon electricity and tramways department, has obtained the position of resident engineer and manager to the Delhi Electric Tramways and Lighting Co., and expects to proceed there next month. Mr. Griffin went to Swindon just four years ago, and supervised, under the consulting engineers, the construction of the power station and the tramways, and organised the combined department. Both the lighting and (until the recent unfortunate accident) the tramways, have shown considerable success, financial and otherwise, under his management. He is going out to perform identical duties in Delhi, and after the construction work is completed will be responsible for the undertaking to the directors in London. The Swindon Committee is now considering the advisability of dividing the duties of the dual position which Mr. Griffin has just resigned.

Tramway Officials.—The Tramways Committee of Halifax T.C. has appointed Inspector W. Drinkwater as tramway traffic superintendent.

Mr. E. J. Marsh, chief electrical superintendent of the Sheffield Corporation Tramways, was presented with a silver tea-service and an illuminated address, on Friday, September 28th, on the occasion of his marriage. The presentation was made by the general manager, Mr. A. R. Fearnley, in the presence of a numerous company presided over by Mr. H. E. Yerbury, the chief electrical engineer.

General.—We are sorry to learn that Mr. Maurice Graham (Graham, Morton & Co.) has recently been laid up for about 12 weeks owing to a serious operation for appendicitis, and has therefore been unable to attend to business. He has now, however, completely recovered, the operation having been successful, and will resume his control of the business of Graham, Morton and Co., who, we are informed, have purchased from the liquidators of Graham, Morton, Ltd., the whole of the drawings, designs, copyrights, patent rights, wood patterns and models, and a large quantity of tools and machinery for the equipment of their new works in Leeds, in order to continue the manufacture of their specialities of elevating and conveying machinery.

Mr. W. L. Winning, for the last 2½ years Glasgow and district representative for the British Electric Plant Co., Ltd., of Alloa, is leaving this position to take up an appointment with the British Westinghouse Electric and Manufacturing Co., Ltd., at their sales department, Scottish district.

Mr. J. D. F. Andrews has removed to offices at 47, Victoria Street, Westminster, S.W., and has disposed of all his trading or commercial interests in consequence of the limiting influence they have hitherto held over his professional pursuits.

At a meeting of the board of the Electric and General Investment Co., Ltd., held on Monday, Mr. J. Cecil Bull was appointed a director of the company, after having acted as secretary since its formation in 1890. Mr. R. S. Shaw was at the same time appointed "secretary *pro tem.*"

Mr. Henry F. Joel has changed his address from 31, Wilson Street, E.C., to 110, Strand, W.C., where he will practise as a consulting electrical engineer and specialist on electric motor-cars. Mr. Joel has had a lengthy practical experience in electrical engineering, being one of the pioneers of electric lighting, power and storage. He is the inventor and patentee of the "Zone" electric motor and of the "Fors" accumulator, and the joint inventor and patentee of the Rosenthal battery.

Obituary.—We regret to learn from the *Times* that the Rt. Rev. Monsignor Molloy, Vice-Chancellor of the Royal University of Ireland, was found dead in his bed at Aberdeen on Monday morning. His name will be familiar to our readers by reason of his many lectures delivered at Dublin on X-ray and wireless telegraph matters. He was in his 73rd year.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Engineers.—The Ilford U.D.C. has appointed Mr. W. E. Claret, of South Tottenham, as shift engineer, vice Mr. F. A. Taylor, resigned.

Mr. E. J. Galvez has been presented with a silver cigarette case by the Hoylake Electricity Works staff, on the occasion of his resigning his post as engineer-in-charge (senior) to take up a special engineering course at the Manchester University.

Mr. H. Brown, mains inspector, Walthamstow, has been appointed canvasser to the undertaking for six months on trial.

The Bridlington T.C. has granted Mr. A. J. Beckett, electrical engineer, an honorarium of £20, and Mr. Mott, his assistant, £10, for extra services rendered in connection with the extension of the electricity plant, &c.

The Bexley U.D.C. has appointed Mr. W. Peyton as engineer's assistant.

The position of mains engineer at the Erith U.D.C. Electricity Works, vacant by the promotion of Mr. H. E. Midgley to be chief assistant engineer, has now been filled by the appointment of Mr. F. Thompson, who was previously shift engineer in the generating station.

NEW COMPANIES REGISTERED.

Galvano Chemical Co., Ltd. (90,108).—This company was registered on September 19th, with a capital of £10,000 in £1 shares (250 5 per cent. preference), to acquire patents relating to the manufacture of chloride of magnesia and red oxide paint, to adopt an agreement with G. F. Thomson, and to carry on the business of manufacturing chemists, druggists, drysalters, oil and colourmen, manufacturers of electrical and other apparatus, &c. The first subscribers (each with one share) are:—G. F. Thomson, Rutlake House, Bedford, chemical engineer; J. Chadwick, 192, Drake Street, Rochdale, dyer; R. H. Pickles, 442, Audenshaw Road, Audenshaw, chemical manufacturer; J. E. Ramsdale, 21, Spring Gardens, Manchester, incorporated accountant; F. B. Estcourt, Langdale, Steven Street, Stretford, agent; H. Bibby, Ladybarn Lane, Withington, Manchester, manufacturing chemist; and W. H. Watson, 13, Tenby Avenue, Withington, Manchester, accountant. No initial public issue. Table "A" (revised form) mainly applies. Registered office, 21, Spring Gardens, Manchester.

Amalgamated Radio-Telegraph Co., Ltd. (90,129).—This company was registered on September 15th, with a capital of £450,000 in £1 shares, to adopt an agreement with the De Forest Wireless Telegraph Syndicate, Ltd., to acquire and turn to account inventions and rights relating to wireless or other telegraphs, telephones, &c., and to carry on the business of owners of telegraph and telephone systems, electricians, electrical and general engineers, &c. The first subscribers (each with one share) are:—G. E. Sanders, Bloomfield Lodge, Larkfield, Richmond, Surrey, clerk; W. Farrier, 40, Brunswick Road, Leyton, clerk; E. S. Harper, 87, Glenfarg Road, Catford, S.E., clerk; H. W. Brown, 63, Mackenzie Road, Beckenham, clerk; E. Wyatt, Wyndham, Uplands Road, Crouch End, N., clerk; F. H. Goodwin, 7, Narford Road, Upper Clapton, N.E., clerk; and P. M. Cullen, 30, Paxton Road, St. Albans, Herts., clerk. No initial public issue. The number of directors is not to be less than seven or more than eleven. The subscribers are to appoint the first; qualification, £250; remuneration, £250 per annum for the chairman, and £125 each for the others.

Goodman Manufacturing Co., Ltd. (90,153).—This company was registered on September 18th, with a capital of £50,000 in £1 shares (20,000 "A" and 30,000 "B") to carry on the business of manufacturers of and dealers in coal and other mining machinery, electric mine locomotives, dynamos and mining supplies of all kinds, engineers, founders, smiths, machinists, &c. The "A" and "B" shares each carry a cumulative dividend of 6 per cent. on the amounts paid up thereon. The surplus profits (after providing for reserve fund, if any) are to go to the "A" shares in proportion to the nominal amounts thereof, whether fully paid up or not, and to the "B" shares in proportion to the amounts paid up thereon. The first subscribers (each with one "B" share) are:—H. E. Goodman, Halsted Street, Chicago, director; A. J. Bloemendal, 14A, St. James' Court, S.W., engineer; H. H. Court, 69, Aldersgate Street, E.C., solicitor; F. G. Smithson, 7, Brookfield Road, Bedford Park, W., clerk; J. N. Clarke, 5, St. Helens Road, Westcliffe-on-Sea, director; J. Mann, 15, Barbican, E.C., builder; and T. M. Bathurst, 55, Downs Park Road, N.E., clerk. No initial public issue. The number of directors is not to be less than three or more than five; the first are F. S. Washburn and H. E. Goodman (both of Chicago), A. J. Bloemendal, W. H. Court and one other to be nominated by the said H. E. Goodman; remuneration (except A. J. Bloemendal), five guineas each per board meeting attended. Registered office, 69, Aldersgate Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Issue on August 21st of £200 5 per cent. debentures, part of series created June 1st, 1904, to secure £2,000 charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £800.

General Electric Co., Ltd. (67,307).—This company's annual return was filed on August 8th, when 25,000 preference and 33,122 ordinary shares had been taken up out of a nominal capital of £800,000 in 40,000 preference and 40,000 ordinary shares of £10 each; £10 per share has been called up on 18,000 preference and 8,122 ordinary, resulting in the receipt of £261,220; £320,000 is considered as paid on 7,000 preference and 25,000 ordinary. Mortgages and charges: £200,000.

Spanish Telephone Co., Ltd. (41,589).—This company's annual return was filed on July 25th, when 1,600 ordinary and 641 preference shares had been taken up out of a nominal capital of £41,000 in 1,600 ordinary shares of £10 each and 1,250 preference shares of £20 each; £20 per share has been called up on 641 preference, resulting in the receipt of £12,820; £16,000 is considered as paid on 1,600 ordinary. Mortgages and charges: Nil.

D.P. Battery Co., Ltd. (44,084).—This company's annual return was filed on September 5th, when the entire capital of £10,000 in 4,996 "A," 4,996 "B," and 8 other shares of £1 each had been taken up and paid for in full. Mortgages and charges: £14,000.

Sunbeam Lamp Co., Ltd. (25,498).—This company's annual return was filed on August 9th, when 1,765 shares had been taken up out of a nominal capital of £25,000 in 2,500 shares of £10 each. £10 per share has been called up on 908 and £9,080 has been received. £8,570 is considered as paid on 857. Mortgages and charges: £8,500.

Thomas Parker, Ltd. (40,973). — This company's annual return was filed on August 15th, when the entire capital of £75,000 in 7,500 shares of £10 each had been taken up. £10 per share has been called up on 5,750, resulting in the receipt of £57,500. £17,500 is considered as paid on 1,750. Mortgages and charges: £65,000.

Consolidated Supply Co., Ltd., Electrical Engineers, London (85,838).—Issue on September 5th of £10,500 5 per cent. debentures, part of series created July 18th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Consolidated Electrical Co., Ltd., Broad Street House, E.C. No trustees. No previous issue of same series. A memorandum of satisfaction in full of debentures dated October 6th, 1905, and January 1st, 1906, securing in all £3,000, has also been filed.

Monobloc Accumulator Syndicate, Ltd. (64,142).—This company's annual return was filed on August 13th, when 10,000 shares had been taken up out of a nominal capital of £20,000 in £1 shares. £7,000 has been received and £3,000 is considered as paid. Mortgages and charges: Nil.

Brockie-Pell Arc Lamp, Ltd. (66,602).—This company's annual return was filed on July 17th, when 79,751 shares had been taken up out of a nominal capital of £80,000 in £1 shares. 2s. 6d. per share has been called up, resulting in the receipt of £9,980 5s. 6d., including £12 5s. 6d. paid on 221 forfeited shares. 17s. 6d. remains in arrears. £69,776 (17s. 6d. per share) is considered as paid on 79,744 shares. Mortgages and charges: Nil.

Cape Town Consolidated Tramways and Land Co., Ltd. (89,037).—A trust deed dated August 14th, to secure £450,000 debentures created by resolution of July 10th, 1906, has been registered. Property charged: 160,000 fully paid £1 shares in Camp's Bay Tramway Co., Ltd., 75,000 fully paid £1 shares in the Cranjezicht Estate, Ltd., and 85,000 fully paid £1 shares in the Cape Marine Suburbs, Ltd. Trustees: L. Breitmeyer, 1, London Wall Buildings, E.C.; and Dr. F. Rutherfoord Harris, 101, Mount Street, W. None of the debentures have been issued.

Power Plant Co., Ltd. (79,151).—This company's annual return made up to December 31st, 1905, was filed on August 9th. 2,501 shares have been taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on seven, and 17s. per share on 2,494, resulting in the receipt of £2,126 18s. Mortgages and charges: Nil.

Edmundson's Electricity Corporation, Ltd. (52,013).—This company's annual return was filed on August 17th, when the entire capital of £800,000 in 80,000 ordinary, and 80,000 preference shares of £5 each had been taken up. £5 per share has been called up on 146,800 shares, and £734,000 has been received. £66,000 is considered as paid on 13,200 shares. Mortgages and charges: £435,000.

Henley's (South Africa) Telegraph Works, Ltd. (77,781). —This company's annual return was filed on July 31st, when the entire capital of £2,000 in £1 shares had been taken up and paid for in full. Mortgages and charges: nil.

Middleton Electric Traction Co., Ltd. (68,935).—This company's annual return, made up to May 16th, was filed on July 30th. The entire capital of £100,000 in 10,000 ordinary and 10,000 preference shares of £5 each has been taken up and paid for in full. Mortgages and charges: £50,000.

Anchor Cable Co., Ltd. (69,073).—This company's annual return was filed on July 30th, when 6,500 had been taken up out of a nominal capital of £250,000 in £10 shares. £10 per share has been called up on 4,600, and £5 per share on 1,500, resulting in the receipt of £53,500. £4,000 is considered as paid on 400 shares. Mortgages and charges: nil.

Easton Lift Co., Ltd. (81,115).—Issue on September 5th of £4,000 5 per cent. debentures, part of series created same date to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Brisbane Electric Tramways Investment Co., Ltd. (67,853).—An acknowledgment of indebtedness dated September 7th, 1906, creating £25,000 further debenture stock (making, with £425,000 already created, a total of £450,000), and being supplemental to a trust deed of November 21st, 1900, covering £500,000 debenture stock, has been registered. Property charged: Shares of £749,645 nominal value in the Brisbane Tramways Co., Ltd. Trustees: Sir H. Seymour King, M.P., 65, Cornhill, E.C.; and E. D. Vaisey, 39, Threadneedle Street, E.C.

Dewsbury Electric Manufacturing Co., Ltd. (85,100).—A 5 per cent. debenture for £410, dated September 12th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: J. Bentley, 11, Grange Road, Horton, Bradford.

Scottish House-to-House Electricity Co., Ltd. (29,232).—This company's annual return was filed on August 7th, when 970 ordinary and 100 founders' shares had been taken up out of a nominal capital of £100,000 in 14,900 ordinary, 5,000 preference and 100 founders' shares of £5 each. £5 per share has been called up, resulting in the receipt of £5,350, in addition to £108 paid on 54 forfeited shares. Mortgages and charges: £98,618 1s. 4d.

City of Birmingham Tramways Co., Ltd. (49,458).—This company's annual return was filed on July 10th, when 60,000 ordinary and 40,000 preference shares had been taken out of a nominal capital of £1,000,000 in 120,000 ordinary and 80,000 preference shares of £5 each. £5 per share has been called up on 6,047 ordinary and 40,000 preference and £1 per share on £53,953 ordinary, resulting in the receipt of £284,191, including £3 paid on three forfeited shares. Mortgages and charges: £300,000.

Yorkshire Private Telephone Co., Ltd. (76,692).—This company's annual return was filed on August 24th, when £5,550 shares had been taken up out of a nominal capital of £6,000 in £1 shares. £1 per share has been called up on 3,475, resulting in the receipt of £3,475. 2,075 shares are considered as fully paid. Mortgages and charges: Nil.

Crompton & Co., Ltd. (27,200).—This company's annual return was filed on August 17th, when 85,000 shares had been taken up out of a nominal capital of £300,000 in 100,000 shares of £3 each. £3 per share has been called up on 83,000, resulting in the receipt of £249,000. £6,000 is considered as paid on 2,000 shares. Mortgages and charges: £100,000.

Blackburn, Starling & Co., Ltd. (61,302).—This company's annual return was filed on September 15th, when 8,483 shares had been taken up out of a nominal capital of £12,000 in £1 shares. £4,583 has been received, and £3,900 is considered as paid. Mortgages and charges: nil.

Sloan Electrical Co., Ltd. (61,528).—This company's annual return was filed on August 11th, when 5,000 "A" preference, four "B" preference, and 2,750 ordinary shares had been taken up out of a nominal capital of £15,000 in £1 shares (5,000 "A" preference, 5,000 "B" preference, and 5,000 ordinary). £1 per share has been called up on four "B" preference, and 1,250 ordinary. £6,500 is considered as paid on 5,000 "A" preference, and 1,500 ordinary. Mortgages and charges: nil.

Uxbridge and District Electric Supply Co., Ltd. (62,706).—Issue on September 11th of £300 5 per cent. debentures, part of series created July 14th, 1904, to secure £35,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £33,400.

British Electric Co., Ltd. (London) (83,338).—Issue on September 3rd of £200 10 per cent. debentures, part of series created October 13th, 1905, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £50.

Electric Supply Corporation, Ltd. (52,036).—This company's annual return was filed on August 9th, when 41,500 shares had been taken up out of a nominal capital of £250,000, in 50,000 shares of £5 each. £5 per share has been called up on 30,800, and £4 per share on 3,700, resulting in the receipt of £168,683. £117 remains in arrears; £35,000 is considered as paid on 7,000 shares. Mortgages and charges, £50,000.

Electric Construction Co., Ltd. (39,292). — This company's annual return was filed on August 16th, when 31,390 preference and 112,100 ordinary shares had been taken up out of a nominal capital of £400,000 in 50,000 preference and 150,000 ordinary shares of £2 each. £2 per share has been called up on 18,245 preference and 2,100 ordinary, and £40,690 has been received. £246,290 is considered as paid on 13,145 preference and 110,000 ordinary. Mortgages and charges, £250,000.

Malaga Electricity Co., Ltd. (48,076). — This company's annual return was filed on September 5th, when 10,000 ordinary and 7,000 preference shares had been taken up out of a nominal capital of £57,000 in 10,000 ordinary and 7,000 deferred shares of £5 each. £5 per share has been called up on the ordinary, and £50,000 has been received. £7,000 is considered as paid on the deferred shares. Mortgages and charges, £44,738.

Accessories Manufacturing Co., Ltd. (84,107).—This company's annual return was filed on August 2nd, when £2,443 preference and 1,064 ordinary shares had been taken up out of a nominal capital of £10,000 in £1 shares (5,000 preference). £7 has been received, and £3,500 is considered as paid. Mortgages and charges: £2,500.

Altrincham Electric Supply, Ltd. (40,795).—This company's annual return was filed on August 2nd, when 25,000 shares had been taken up and paid for in full out of a nominal capital of £50,000 in £1 shares. Mortgages and charges: £25,000.

Private Wire and Telephone Installation Co., Ltd., London (76,888).—£1,000 5 per cent. debentures, created August 24th and dated September 19th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holders: Consolidated Electrical Co., Ltd., Broad Street House, E.C.

Fleetwood and District Electric Light and Power Syndicate, Ltd. (49,666).—A charge securing not more than £1,360 was created by the Receiver (pursuant to three Orders of Court) on September 12th. Property charged, the company's undertaking and assets (ranking in priority to a trust deed dated October 31st, 1899). Holder: W. C. Johnson, Broadstone Farm, Coleman's Hatch, Sussex.

La Capital Traction and Electric Co., Buenos Ayres, Ltd. (62,311).—Particulars of a series of debentures created December 21st, 1900, to secure £600,000 (liable to increase to £800,000) have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900, a debenture of recent date being produced to the Registrar. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: W. Trotter, 31, Throgmorton Street, E.C.; and R. Fleming, 2, Prince's Street, E.C.

Morris-Hawkins Electrical Co., Ltd. (81,691).—A board resolution under seal, dated September 19th, 1906, creating £11,000 5 per cent. debenture stock, has been registered. Property charged: The company's lands, freehold and leasehold properties, patent rights, buildings, works, undertaking and uncalled and unpaid capital, present and future.

Leeds Copper Works, Ltd. (62,235).—£50,000 debentures (two of £25,000 each), created September 5th and dated September 19th, 1906, have been registered. Property charged: The company's property, present and future, as a second floating security. No trustees.

Electric Law Press, Ltd. (London).—Issue on August 30th of £50 7 per cent. debentures, part of series created November 9th, 1905, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £800.

Exchange Telegraph Co., Ltd. (6,152 C).—This company's annual return was filed on September 19th, when 8,023 "A" and 16,200 "B" shares had been taken up out of a nominal capital of £246,250 in 8,125 "A" and 16,500 "B" shares of £10 each. £9 per share has been called up on 6,000 and £1 per share on 2,023 "A" shares, resulting in the receipt of £56,023. £162,000 is considered as paid on the "B" shares. Mortgages and charges, nil.

CITY NOTES.

Dick, Kerr & Co., Ltd.

The ordinary general meeting of the shareholders of this company was held on Thursday of last week, at the Cannon Street Hotel, Mr. John Kerr presiding.

In proposing the adoption of the report (see Electrical Review, September 21st, p. 467), the Chairman said that the financial year just ended had not been characterised by any circumstances of an exceptional character. The volume of work executed had been greater than any previous year, but, unfortunately, this gratifying position had been largely discounted by a keener competition. In many cases they had had to be content to see what should have been good business go past them, through, as it seemed to the directors, a cutting of prices to a point which would not be wise to follow. He was sorry to say he could not see any possibility in the near future of much amelioration in this direction. At the moment the productive power in England of electrical engineering works was somewhat beyond the demand. The manufacturers in this country had not the absolute command of the home trade, or the trade of our Colonies or Dependencies. They had to deal with things as they found them, and to be able to cope with this keen competition, it was the directors' desire to be alert in effecting every economy in production. Not only had efficiency in every department to be carefully watched, but it was all important to strengthen the company's financial position. The payment of large dividends was pleasing, but the directors' first consideration was to have the company placed in such security that shareholders would be able to pass through a period of depression without anxiety, should such a period occur. In addition to the usual amount of depreciation which had been written off, and which the auditors in their report characterised as ample, a sum of £15,000 had been set aside to the special reserve for extensions of manufactories or replacements of machinery, &c., or special depreciation of the same. This fund now amounted to £50,000. The directors trusted the shareholders would approve of this conservative policy. By reason of the large business done the creditors figured at £432,978, as against £333,287 last year, or an increase of about £100,000. The amount outstanding on contracts, stock of materials, &c., was £669,131, as against £495,456, or an increase of £173,675. It would be a satisfaction to them to know that the bulk of the amount for accounts due at June 30th last had been paid. He had explained at previous meetings that in connection with most of their contracts they had to accept a clause providing for a considerable retention money extending in many cases over 12 months. The busier they were, naturally meant the lock-up of a larger amount of money. By having their funds well in hand, they were able to buy in the cheapest market for cash payments. Last year the balance carried forward was £42,387. This year it was proposed to carry forward £56,076, which was equal to more than 20 per cent. to the ordinary shares. The directors, who held the bulk of the ordinary shares, were satisfied that the best policy was not to recommend a dividend beyond 10 per cent. on those shares. During the year Mr. Flett, the managing director, went out to the East in the interest of the company. Among other places he visited Japan, where they had just completed a considerable business, and the directors trusted that considerable benefit would accrue from the experience gained by Mr. Flett in his Eastern tour.

Mr. Claud T. Cayley seconded the motion, and the report was adopted.

Yorkshire Power Electric Co.

A half-yearly meeting was held at Leeds on 25th ult., Mr. A. G Lupton, who presided, said that although the progress of the company had not been as rapid as they could have wished, there was much ground for satisfaction with what had been done. Increasing confidence was being shown in the company, as was evidenced in the fact that the average length of agreements was between six and seven years, and a large percentage of the increase was with customers who had commenced with small instalments—a satisfactory proof that the consumers appreciated the advantages offered by the company. Another ground for satisfaction was the better feeling that prevailed between the company and the local authorities in their area. Fully one-half of their present output was in areas which at first were cut off from them. The change showed that the local authorities had come to recognise the benefits the company offered to ratepayers and industries. The company, too, had been able to centralise the whole of their staff at Thornhill. Not long ago the directors had agreed to forego one-half of the fees that had been voted to them, as most of the initial work of the company had not been completed. They had now decided to forego the whole of their fees until such time as the company might be even more prosperous.

Halifax and Bermudas Cable Co., Ltd.

The directors' report shows that the net result of the year's working is a profit of £3,274, as compared with £2,698 for the previous year. An interim dividend of 2½ per cent., free of income-tax, has already been paid, and it is now proposed to make a further equal payment, free of income-tax, which will leave £774 to be carried forward. This will increase the amount to the credit of revenue account to £18,010. The company's cable continues to work efficiently. During the year debentures have been paid off to the amount of £8,600, leaving £37,900 outstanding.

Direct West India Cable Co., Ltd.

The directors' report for the year ended June 30th, 1906, shows a net profit of £3,113, as compared with £4,182 for the previous year. An interim dividend of 3 per cent., free of income-tax, has already been paid, and it is now proposed to make a further equal payment, free of income-tax, which will leave £1,313 to be carried forward. This will increase the amount to the credit of revenue account to £36,125. The company's cables continue to work efficiently. During the year debentures have been paid off to the amount of £9,000, leaving £65,500 outstanding.

The Edison & Swan United Electric Light Co., Ltd.

The twenty-third annual report for the year ended June 30th, 1906, states that the net revenue account shows that the sum of £53,710 has been brought forward from profit and loss account. Interest on debenture stocks has absorbed £16,730; £11,000 has been set aside as depreciation on freehold and leasehold property, plant, machinery and tools; £1,508 has been applied in writing down values of stocks; and the sum of £1,322 has been reserved on account of bad and doubtful debts. An amount of £5,000 has been placed to a reserve fund. The result as shown in the net revenue account is a credit balance of £18,150, to which must be added the sum of £6,835 brought forward from the previous year, thus making a total of £24,985, out of which the directors recommend the payment of a dividend for the year on the "A" shares at the rate of 4⅛ per cent. (being 4s. 2d. per fully-paid "A" share and 2s. 6d. per part-paid "A" share), amounting to £15,978, leaving a sum of £9,007 to be carried forward. During the year £8,381 of this company's debenture stocks has been purchased and cancelled, resulting in a profit of £1,069, in addition to that already mentioned. This amount has been appropriated as a reserve against stock depreciation. The cost of establishing the business, goodwill, &c., £443,451, as per last balance-sheet, has been reduced by £53,019, being the amount written off the "B" shares during the year. The freehold and leasehold property, plant and machinery have also been brought forward at the value stated in the last balance-sheet, with the addition of the amount expended to June 30th, 1906, less depreciation charged in net revenue account. There has been expended on capital during the year ending June 30th, 1906, £7,440. The shares of the Altrincham Electric Supply, Ltd., have been taken at par, as in previous years. This concern continues to show satisfactory progress, having this year, for the first time, paid a dividend on its shares. Its indebtedness to this company has been reduced during the year by £1,865. Subject to audit, the directors have decided to recommend the payment of a dividend for the year ending June 30th, 1906, at the rate of 4⅛ per cent. per annum, being 2s. 6d. per cent. on the "A" shares partly paid, and 4s. 2d. per share fully paid, each less income-tax.

The annual meeting will be held on Thursday, October 11th, and if approved dividend warrants will be posted on the same day. The transfer book will be closed from 28th inst. to 11th prox.

Prospectuses. — *Newcastle-upon-Tyne Electric Supply Co., Ltd.*—The public has this week been invited to subscribe for an issue of £187,500 4½ per cent. second mortgage debentures at par.

The British Guiana Rubber Corporation, Ltd.—This company has this week been offering an issue of 40,000 shares of £1 each. The company has been formed to acquire certain rubber-planting leases or licences granted by the Government of British Guiana. It is estimated that there are 75,000 mature trees on the property, and tapping will commence immediately.

Pataling Rubber Estates Syndicate, Ltd.—An interim dividend of 2s. per share has been declared.

New St. Helens and District Tramways Co.—The report for the year ended June 30th shows a loss of £37, increasing the debit to profit and loss to £2,054. The amount of preference dividend unpaid at June 30th was £21,972. The preference share capital redemption fund amounts to £2,344.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Hadfield's Steel Foundry Co., Ltd.—Further issue of 10,000 4½ per cent. cumulative preference shares of £10 each, fully paid, Nos. 20,001 to 30,000.

Lancashire United Tramways, Ltd.—£250,000 5 per cent. prior lien debenture stock.

Willans & Robinson, Ltd.—The annual meeting of this company was held on Wednesday afternoon. The report (see Electrical Review, September 28th) was adopted by 32 votes to 17. Our account of the proceedings will appear next week.

MARKET QUOTATIONS.

Wednesday, October 3rd.

	CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	32/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	" "	per ton	£30	..
a	Bleaching powder	per ton	£5 10	..
a	Bisulphide of Carbon	per ton	£18	..
a	Borax	per ton	£15	..
a	Benzole (90 %)	per gal.	10½d.	..
a	" (50 %)	per gal.	10d.	..
a	Copper Sulphate	per ton	£26	..
a	Lead, Nitrate	per ton	£28	..
a	" White Sugar..	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a	Potassium Bichromate, in casks	per lb.	3½d.	..
a	Potash, Caustic (75/80 %) ..	per ton	£20	..
a	Potassium Cyanide	per lb.	8½d.	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	" Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	" Crystals	per ton	£3 5	..
a	Sodium Bichromate, casks ..	per lb.	2⅞d.	..
a	" Cyanide	per lb.	7½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£200	..
b	" Wire, in ton lots ..	per ton	£220	..
b	" Sheet, in ton lots ..	per ton	£210	..
b	Babbitt's metal ingots	per ton	£48 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	9⅝d.	⅛d. inc.
c	" Tube (brazed)	per lb.	11½d.	⅛d. inc.
c	" " (solid drawn).. ..	per lb.	10¾d.	⅛d. inc.
c	" Wire, basis	per lb.	9¼d.	⅛d. inc.
c	Copper Tubes (brazed)	per lb.	1/0½	..
c	" " (solid drawn) ..	per lb.	1/1	⅛d. inc.
g	Copper Bars (best selected) ..	per ton	£108	£7 inc.
g	Copper Sheet	per ton	£108	£7 inc.
g	" Rod	per ton	£108	£7 inc.
e	" (Electrolytic) Bars ..	per ton	£98	£4 inc.
e	" " Sheets ..	per ton	£110	£4 inc.
e	" " Rod ..	per ton	£101	£4 inc.
e	" " H.C. Wire	per lb.	1/0½	⅜d. inc.
f	Ebonite Rod	per lb.	3/3	..
	" Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/8	1d. inc.
h	Gutta-percha, fine	per lb.	6/- to 7/-	..
h	India-rubber, Para fine	per lb.	5/1	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	54/6½	1½d. inc.
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£19 to £19 2 6	5/- inc.
g	" " Sheet	per ton	£21 to £21 2 6	5/- inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d	" " " medium	per lb.	2/6 to 4/-	..
d	" " " large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p	" rolled bars & rods	per lb.	1/1½ to 1/3	..
p	" " strip & sheet	per lb.	1/4	..
o	Platinum	per oz.	nominal	..
e	Silicium Bronze Wire	per lb.	1/- to 1/1	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£68	..
	" " in bars		£15 to £40	..
g	Tin, Block (English)	per ton	£194 to £195	£10 10s. inc.
n	" Wire, Nos. 1 to 16	per lb.	2/4	1d. inc.
p	White Anti-friction Metals—			
	"White Ant" brand	per ton	£46 to £70	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£32 15	15/- inc.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Mexico Electric Tramways, Ltd.—At an extraordinary meeting held on Tuesday certain alterations in the Articles were agreed to, the object being to enable a register of shares to be kept in Toronto, where the largest number of shares was held, and where the entire business of the company would in future be conducted.

Bruce Peebles & Co., Ltd.—An interim dividend at the rate of 6 per cent. per annum on the preference shares has been declared for the half-year ending June 30th, 1906, and the warrants have been posted.

STOCKS AND SHARES.

Tuesday Evening.

"The Stock Exchange is a good place," declared one of its members, "to get out of." When prices fall, business shrinks, and prices have sunk into bad ruts lately. Money dominates the situation, making Consols flat, and investment stocks dull as a whole. The 5 per cent. Bank Rate is said to be hovering on the near horizon.

Home Railway stocks are extremely weak. The strike on the Clyde has introduced a new element of anxiety into the market, and the demands of labour grow more vocative as the time approaches for the reassembling of Parliament. Prices of stocks in all the trunk lines are on the decline, but the only alteration which this has caused amongst electrical railway issues is a drop of 2 points in Waterloo and City stock, which has fallen to 102½. The "Tube" lines are unchanged.

"Sewer" stocks, however, continue depressed. Metropolitan Consolidated has again fallen, this time to 59½. Districts keep about 22. Judged by the weekly traffic returns, the agitation over the raised fares is having little effect, but other evidence shows unmistakeably that the advanced prices are driving many travellers on to other systems.

Business in British Electric Traction Ordinary has been done at 4 9/16, and in the Preference at 8 9/16 this week. It is not surprising that questions are being raised as to the whereabouts of the support which usually comes to the rescue of the market when prices fall like this. Inquiries were made the other day by a representative of the *Westminster Gazette* at the office of the company to see whether any explanation of the fall could be given there. But the journalist did not glean much in the way of information. There are some people who attribute the weakness to realisation of a decreased account. It requires little acumen, however, to find out that many shareholders were dissatisfied with the last report, and but little memory to recollect that some of them challenged the advisability of distributing the last dividend on the Ordinary shares, declaring it not to have been earned. Already, anticipation looks for the next interim dividend to be passed, and the financial methods of the company have never been regarded with great favour by a good many people. London United Tramways shares keep up pretty steadily, and the Brush Electrical issues show no change.

Telegraph descriptions are good. In those four words lies the only consolation to the loyal followers of electrical securities. The gamble in American rails rolls merrily along, and Anglo-American Telegraph "A" stock is decidedly better in sympathy. The "B" stock, however, came on offer and is slightly lower, the same thing having occurred in Direct United States Cable shares. Cuba Telegraphs are 8¾ for the Ordinary, 17½ for the Preference, the American occupation of the island producing no change in the prices of the shares. Amazons rose to 4, and the Debentures to 90½. Reuters are better at 7⅝, an alteration being so infrequent as to demand particular comment. Western Telegraph rose ½ to 14⅝, but "China" shares have lost their recent advance, slipping back to 14½. Yet Eastern Ordinary and Preference are both ½ better. Direct Spanish of each kind have recovered the dividends deducted last week from the prices. The Direct West India Company declares a dividend of 3 per cent.

National Telephone Preferred and Deferred are ½ better, keeping level at 110½, but the 4 per cent. Debenture is easier at 103.

Falls predominate amongst electricity supply shares. Westminsters are ¼ lower at 10, so are St. James' at 10¼. Urban Ordinary at 3½ and the Preference at 4½ are both 5s. down. South Londons moved down to 2⅞, while Smithfields simply collapsed upon a very slight pressure to sell. The shares are nominally 30s. The only quotable rise is one of ¼ in Hove shares, which are 8½, continuing their improvement of a week ago. New Calcuttas weakened to 4¼, and Oxfords to 6⅜.

All electric traction descriptions are not flat. British Columbia Electric Railway Deferred has risen substantially, partly in sympathy with the swift advance in Canadian railway and land shares. Anglo-Argentine Tramways are 7⅛, *ex* the 4s. dividend, and a rise of 1/16 makes the Preference 5 1/16. Buenos Ayres and Belgrano Preferences recovered some of the 3s. per share deducted for dividend, and Calcutta Trams at 8¼ are *ex* 3s. 6d.

For Willans & Robinson to have lost only 5s. after the issue of the report, must be regarded as satisfactory by the unfortunate shareholders. Edison and Swan are up to 1⅞, and 2¾ for the partly and the fully-paid shares respectively. The dividend declaration is considered good. Bruce Peebles and Dick, Kerr Preference are *ex* dividend: so are Babcock & Wilcox Ordinary and Preference, but these markings have caused no remarkable changes in prices. Vickers, Sons & Maxim have eased off a shade in consequence of fears lest the labour trouble on the Clyde should spread southwards.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Sept. 25th.	Closing Quotations Oct. 2nd.	Business done week ended Oct. 2nd, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	8¼ — 4	8⅜ — 4½	78/1½	..	+ ½
155,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	87 — 92	84 — 93	..	..	+1
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2½%	3½%	65½ — 68½	66⅝ — 68⅝	68	66	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6¼%	6 %	113⅛ — 114½	113 — 114	114	113	— ½
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	¼%	23⅜ — 25⅜	24⅜ — 24⅞	24 9/16	23 5/16	+ ½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..
1,922,856	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	96 — 98 xd	98½	97½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8¼ — 9	8¼ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,381	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝ xd	72/6	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞ — 9½	8⅞ — 9½ xd	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
60,710	Direct United States Cable	20	3½%	3 %	3½%	4½%	15⅛ — 16	15⅝ — 15⅞	15⅞	15½	— ⅛
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
4,000,000	Eastern & Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	144 —147	144½ — 147½	146½	145½	+ ½
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	90 — 92	90½ — 92½	91⅝	91½	+ ½
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	108¼	108	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	14½ — 15	14⅝ — 14⅞	14⅝	14⅜	— ⅛
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105⅛ —107½	105⅛ —107½	..	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000	Do. 4 % Reg. M. Debs. (Mauritius S & b.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5½%	10⅜ — 11½	10⅝ — 11½	11½	11	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜ — 14⅝	14⅜ — 14⅝	..	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	36 — 38	36 — 38	38	37⅜	..
37,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	59 — 61	59 — 61	59½	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅛ — 1 3/16	1 — 1¼	22/6	..	..
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	3 %	4 %	..	⅛ — 1 3/16	⅛ — 1 3/16	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	109 —111	109½ —111½	110⅜	109	+ ½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	109 —111	109 —111	110⅛	109½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅛ — 12½	10⅛ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	5 11/16	5⅝	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	99½	99¼	..
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102½ —104½	102 —104	103⅜	..	— ½
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	7½%	1 5/16 — 1 7/16	1 5/16 — 1 7/16	27/6	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	+ ⅛
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	97	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 7¾	7⅞ — 7⅞	..	..	+ ⅛
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	129 —132	129 —132	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7½	7 — 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½ — 5¾	5½ — 5¾	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	109 —112	..	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10⅛	9⅜ — 10⅛	..	..	..
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	Nil	Nil	Nil	Nil	¾ — ⅞	¾ — ⅞	..	..	..
150,009	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	106⅛ — 108½	100¼ — 108½	..	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	5 %	14⅛ — 14⅜	14⅜ — 14⅝	14 11/16	14½	+ ⅛
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. ..	.. ..	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —106	103 —106	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref. ..	10	7 %*	7 %*	6 %	5 %	6¼ — 6½	6¼ — 6½	..	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5½	4½ — 5½	..	..	..
80,000	Do. do. 5 % Debs., Nos. 1 to 1,600 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 200,008 to 430,007 ..	5	..	..	5 %	5 %	7¼ — 7½	7 — 7¼ xd	7 5/16	7 1/32	..
100,000	Do. Nos. 430,008 to 910,007 and 568,008 to 580,607 ..	5	..	..	..	..	6¾ — 7⅛	7 — 7¼	7 5/16	7	+ ⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	6¼ — 6	5 13/16 — 6 1/16	5 15/32	5 29/32	+ 1/16
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	138 —141	138 —141	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105	103 —105	..	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	20 %	4 — 4¼	3⅞ — 4⅛ xd	80/7½	77/6	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅛ — 1⅜	1 7/16 — 1 5/8 xd	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	3¾ — 4⅛	5⅜ — 5⅝	5¼	80/7½	+1½
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6¼ — 6⅝	6¼ — 6⅝	6⅝	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5½	5¼ — 5½	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
800,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	104 —108	104 —108	100⅜	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	118 —121	122 —125	124	123	+4
800,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —113	110 —113	1 2⅛	110½	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	107 —110	107 —110	109½	108⅜	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	104 —106	104 —106	..	..	..
200,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
138,301	British Electric Traction	10	8 %	6 %	6 %	3 %	5⅜ — 5⅝	4½ — 5⅛	5⅛	91/8	— ⅜
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8⅛ — 9⅜	8½ — 9¼	8⅝	8 9/16	+ ⅛
1,415,422	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	112 —116	109 —113 xd	111⅝	109½	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92½ — 95½	92½ — 95½	94	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¼ — 6⅝ xd	6¼ — 6⅝	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6¼	5⅝ — 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	97 —100	94 — 98	..	..	—2½
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1½ — 1⅝	1½ — 1⅝	27/6	..	..
1,016,358	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 83	77 — 83	78	77½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅝ — 1¾	1⅝ — 1¾	..	..	..
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3½ — 3¾	3½ — 3¾	..	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5¼ — 5⅝	5¼ — 5⅝ xd	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	5 — 5¼	4⅝ — 5⅛ xd	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	..	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8⅛ — 8⅜	8 — 8⅛ xd	..	..	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	105	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10½ — 11½	10½ — 11½	11	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5¾	5⅜ — 5¾	5⅜	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅜ — ½	⅜ — ½	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84½	83½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	..	..	..
1,480,000	City and South London Railway	Stock	3½%	3⅝%	3½%	1¾%	42 — 44	42 — 44	43	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	2½%	1⅝ — 1¾	1⅝ — 1¾	..	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	97	95½	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Sept. 25th.	Closing Quotations Oct. 2nd.	Business done week ended Oct. 2nd, 1906.		Rise or Fall—
		†	1902.	1903.	1904.	1905.			Highest	Lowest.	
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	..	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	8 %	6 %	1⅝ — 1⅞	1 15/16 — 1 31/32	..	..	— 1/32
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5¼ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½	..	1⅞ — 1⅞	1⅞ — 2	37/6	36/10½	+ 1/2
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½	..	2⅛ — 2⅛	2⅛ — 2⅛	37/6	52/6	+ 1/2
844,028	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	89 — 94 xd	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	⅛ — ¼	⅛ — ¼	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	85 — 88	85 — 88	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	93 — 97	91 — 94 xd	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3¾ — 4	3¾ — 4	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10 — 11	10¼ — 10⅝	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —103	101 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	12 3/16	..	..
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½%	5⅛ — 5½	5⅛ — 5½	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	107⅛—109½	107⅛—103⅝	..	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	17 — 18	17 — 18	..	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	1½%	Nil	1⅛ — 1⅛	1 15/16 — 1 15/16	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4¼ — 6¼	4¼ — 6¼	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8¼	8 — 8¼	..	..	..
899,980	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	8¼ — 4½	3¾ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8¾ — 9¼	8¾ — 9¼	9 3/16	8¼	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	93 — 96	93 — 96	96½	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	⅜ — ⅝	⅜ — ⅝	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	15/16 — 1	15/16 — 1	18/-	..	..
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	98½—100½	98⅛—100½	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4½ — 5⅛	4½ — 5	..	..	— 1/8
24,500	Potteries E. Tro., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6¼ — 7¼	6¼ — 7¼	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7¼ — 8¼	7¼ — 8¼	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	100 —103	100 —103	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	33¼ — 35½	33¼ — 35½	..	..	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	..	5 %	90 — 92	90 — 92	90 3/16	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	103 —106	101 —104	102	101	—2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	8 %	Nil	Nil	½ — 1½	½ — 1	..	..	— 1/2
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2½ — 3½	2½ — 3	62/6	62/-	— 1/2
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	77 — 82	77 — 82	78	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5⅛— 5⅜	5 — 5⅛ xd	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¼ — 8⅝	8¼ — 8⅝	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8	7⅞ — 8	..	..	..
800,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4⅜— 4⅞	4⅜— 4⅞	..	..	..
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅛— 5	4⅛— 5	..	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4¼	4 — 4¼	82/6	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,486	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5⅜— 5⅝xd	5⅜— 5⅞	..	..	..
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —109	..	..	+ 1/2
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10 — 11	10 — 11	10⅜	10¼	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	12⅛	..	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102¼	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2 5/16 — 3 3/16	2 5/16 — 3 3/16	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8¼ — 9	8¼ — 9	8¾	8 1/16	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11½ — 12	11½ — 12	..	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3⅜— 3⅞	3⅜— 3⅞	..	..	..
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4⅞— 5⅜	4⅞— 5⅜	..	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅛— 5⅜	5 — 5⅛ xd	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	4⅞— 5⅜ xd	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8 — 8½	8½— 8⅝	8	..	+ 1/2
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	6½— 6⅝	6⅝— 6⅞	..	..	..
87,303	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,800	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	15%	12 %	10 %	9⅜— 10⅜	9⅜— 10⅜	..	..	..
90,000	Do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	8	Nil	Nil	3 %	4 %	1⅞— 2⅜	1⅞— 2⅜	..	..	..
60,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8 — 8¼	8 — 8⅛	8⅛	8 1/16	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜— 5⅝	5⅜— 5⅝	..	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞— 8	7⅞— 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝— 6⅛	5⅝— 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½— 14½	13½— 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb...	100	4 %	4 %	4 %	4 %	97 — 99	96 — 98 xd	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅛— 6⅜	6⅛— 6⅜	..	..	— 1/8
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	10 — 11	9⅜— 10⅜	10 5/16	..	— 1/2
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	99½	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2 — 2⅜	1 — 2	..	..	— 3/4
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	74 — 78	74 — 78	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½	8 %	4 %	4 %	2⅜— 3⅛	2⅜— 3⅛	58/1½	..	— 1/8
108,700	South Met. Elec. Lt. & Power (Ord..	1	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..
85,868	*(Late Blackheath and Greenwich* (7 % Pref...	1	Nil	7 %	7 %	7 %	1⅜— 1⅝	1⅜— 1⅝	..	..	..
148,292	*Dist. E.L.Co.)* (4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	103 —106	102 —105 xd	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3¾— 4	3⅜— 3⅞ xd	..	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4½— 5	4⅜— 4⅞ xd	..	..	..
00,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	99 —102	97 —100 xd	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9⅜— 10⅜	9⅜— 10⅜	10 5/16	9 15/16	— 1/2
98,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½— 5⅝	5⅜— 5⅝	..	..	..
	(Originally 5 %—Red. to 4½ % from 31st Dec., 1905.										

Shares not officially quoted:—Mackay Companies, ord., 75—77. Pref. 74—76.

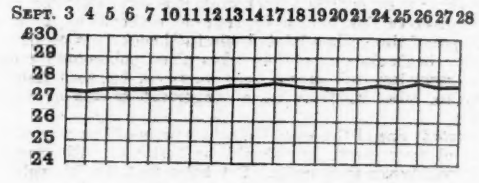
† Unless otherwise stated all shares are fully paid. § Interim dividends.

(Bank rate of discount 4 per cent. September 13th, 1906).

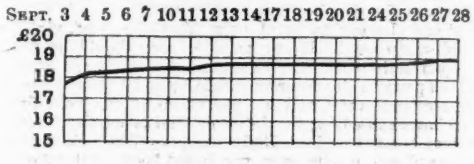
METAL MARKET.

Fluctuations in September.

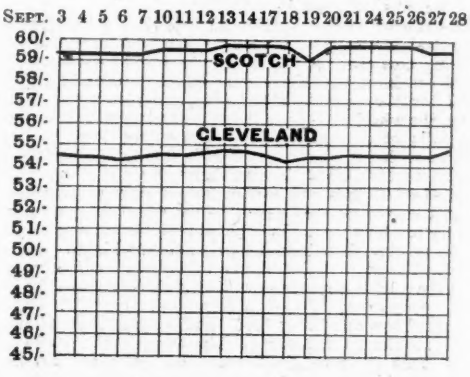
SPELTER (G.O.B's.)



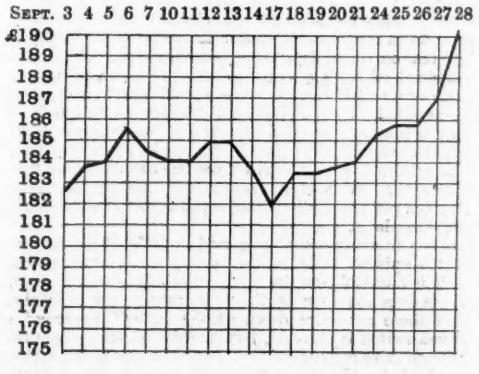
LEAD (ENGLISH)



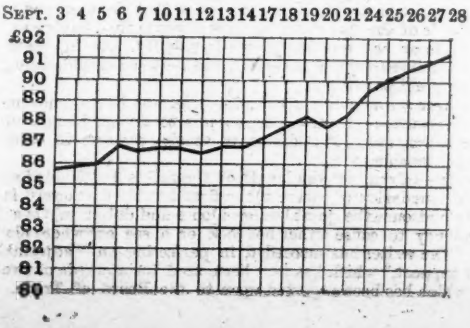
IRON.



TIN.



COPPER (G.M.B's.)



TRADE STATISTICS OF THE AUSTRALIAN COMMONWEALTH FOR 1905.

The following statement of the imports of various classes of material, electrical and other, is taken from the recently issued trade statistics of the Australian Commonwealth for 1905; details for the year 1904 have been added for purposes of comparison:—

Goods and countries of origin.	1904.	1905.
Electrical Materials.—		
United Kingdom	£138,739	£138,002
Germany	28,859	40,275
United States	14,994	22,118
Italy	2,561	1,734
Other countries	4,293	3,597
Total	£189,446	£205,726
Lamps and Lampware.—		
United Kingdom	£34,027	£32,424
Germany	21,422	23,397
United States	19,426	22,282
Other countries	1,719	6,838
Total	£76,594	£84,941
Gas and Oil Engines.—		
United Kingdom	£53,676	£53,535
Germany	846	578
United States	13,304	17,997
Other countries	1,621	1,258
Total	£69,447	£73,368
High-speed and Turbine Engines, Steam and Water.—		
United Kingdom	£17,674	£9,810
Germany	120	—
United States	303	—
Other countries	12	97
Total	£18,109	£9,907
Portable and Traction Engines.—		
United Kingdom	£67,124	£47,455
Germany	205	—
United States	8,293	11,293
Other countries	—	9
Total	£75,622	£58,757
Other Engines.—		
United Kingdom	£83,868	£65,651
Germany	6,143	1,924
United States	4,268	82,674
Other countries	1,691	496
Total	£95,970	£150,745
Electrical Machinery and Appliances.—		
United Kingdom	£109,120	£117,897
Belgium	4,418	1,668
Germany	27,859	11,640
Sweden	—	12,521
Switzerland	—	6,178
United States	86,123	61,329
Other countries	853	2,119
Total	£228,373	£213,352
Mining Machinery.—		
United Kingdom	£98,448	£44,505
Germany	28,517	10,074
United States	18,107	16,739
Other countries	5,568	5,886
Total	£150,640	£77,204
Machinery and parts not specified (includes boilers and pumps).—		
United Kingdom	£386,534	£335,549
Canada	3,799	2,867
New Zealand	5,279	2,312
Germany	32,413	37,066
Belgium	2,913	278
United States	120,459	149,347
Other countries	2,913	2,973
Total	£554,310	£530,392
Iron and Steel Wire.—		
United Kingdom	£25,123	£31,077
Belgium	14,576	2,142
Germany	133,957	161,967
United States	64,668	131,615
Other countries	315	663
Total	£238,639	£327,464

DISTRIBUTION OF ELECTRICAL ENERGY BY CONSTANT CURRENT.

This system, which is discussed in *La Revue Electrique* by M. R. Rougé, is the converse of that used in everyday practice, the variable factor in the power equation being the electromotive force. The current remains constant. Generators, motors, &c., must be run in series. The following table gives some of the characteristics of the two systems:—

Comparative Table of Distribution by Constant Current and Distribution at Constant Pressure.

Elements compared.	Constant current.	Constant pressure.
Constant element of the power.	Intensity of current	Pressure.
Variable ditto. ...	Pressure	Intensity of current.
Nature of generators	Dynamo series ...	Dynamo shunt or with independent excitation.
Most favourable kind of driver.	Torque fixed; speed variable.	Speed fixed; torque variable.
Grouping of generators	In series	In parallel.
Accident cutting off the current.	Short circuit ...	Rupture of circuit.
Accident causing excess load.	Rupture of circuit	Short circuit.
Consequences of this accident.	Rupture of insulation.	Fusion of conductors.
	Transmission Line.	
Fixed loss	Ohmic loss $R I^2$ ...	Loss by leakage $\frac{V^2}{\rho}$
Variable loss ...	Loss by leakage $\frac{V^2}{\rho}$	Ohmic loss $R I^2$.
Limiting factor ...	Pressure compatible with the insulation.	Intensity of current compatible with the section of conductors.

The constant current method holds undoubted advantages in the economical transmission of large powers between distant points. In the first place, the transmission line is most simple, consisting only of a couple of wires, one of which can, in case of necessity, be temporarily replaced by an earth return. Insulation stress is also considerably less than for any other system, because the pressure is regular and without peaks due to resonance effects. Again, the dielectrics are not submitted to periodical internal polarisation, and there is no hysteresis to contend with. Moreover, the insulation is only submitted to the full pressure by the full power; thus for regular transmission, where the full power is only on for a short time, as in electric lighting, the daily insulation stress will be on the average much less than for a line with constant pressure. A countervailing disadvantage is the uniformity of ohmic loss, which diminishes the output and efficiency at low powers.

One of the difficulties of the system lies in the distribution. It is necessary, in order to increase the capacity of a circuit, to increase the resistance in its path, *i.e.*, by adding new motors, &c., in series with the old; and there must be a sufficient number of independent circuits to take the place of an ordinary large network. These circuits, grouped in ray or circular formation, should be able, in hours of light load, to be put in series upon the same group of generating units, and in hours of full load, in direct and independent communication with their own particular generator groups.

The most appropriate prime mover for the generating plant is an engine of variable speed and fixed torque. With a constant field, the constancy of the torque will suffice to assure, without other artifice, the constancy of the current produced. The steam turbine is out of the question, as its output is economical only at a high and uniform speed. The gas engine will not allow of sensitive variation in speed. The most acceptable solution seems to be the multi-cylinder steam engine without fly-wheel but with constant admission.

The difficulty of economical transformation in the sub-station has not yet been suitably solved. This is the weak part of the whole scheme, and until there is some satisfactory solution, the three-phase constant pressure system is likely to retain its supremacy.

Volatilisation of Metals.—The results of experiments to volatilise the metals belonging to the platinum group by means of the electric furnace were recently detailed before the Academie des Sciences by M. Henri Moissan. Melting took place readily with all these metals when a current of 500 to 700 amperes at 110 volts was used. With 500 amperes of current, 150 gm. of platinum reached the melting stage in one or two minutes, and four minutes later that of evaporation. Ruthenium, palladium, iridium and rhodium were evaporated with the same amount of current, but osmium required 700 amperes. The distilled metal resulting from the treatment of the same weight of metal in each case (150 gm.) was as follows: Osmium, 29 gm.; ruthenium, 10 gm.; platinum, 12 gm.; palladium, 9·6 gm.; iridium, 9 gm.; and rhodium, 10·20 gm.

MUNICIPAL TRAMWAYS ASSOCIATION.

Tramway Track Work.

By R. C. Bullough, A.M.Inst.C.E. (General Manager and Engineer, Colchester Corporation Tramways).

(*Abstract of Paper read on September, 20th*, 1906.)

Considering that such a large proportion of the capital of an undertaking is expended on track work, it is surprising that so little heed is given to this branch by tramway authorities. It is only after lapse of time, when joints begin to "knock," paving lifts, rails creep or hogback, corrugation takes place, points and crossings require renewing, and curved rails wear out, &c., that track work begins to takes it place as an important branch of tramway systems.

Concrete is one of the most important parts of tramway construction, and very great care should be bestowed with consequent benefit to future maintenance. Pot holes (soft earth) ought to be removed, and the places filled up with concrete at whatever cost; if this be neglected the concrete will certainly fail. A quick-setting cement may be used, but a slow-setting cement is better where there is time to allow it to set. Cinders or brickbats should not be used, because the depth of concrete is usually so slight that the strongest and cleanest material only should be used, viz., broken stone and sharp sand. Every possible care should be taken to ensure a perfectly solid foundation, and the writer is of opinion that where possible the concrete should be laid *in situ* at the proper level to receive the rail, and not packed up at the joint first and then the metals filled in; this latter method is usually favoured by contractors because it is a little cheaper. The writer saw some joints opened out on a tramway which had been constructed in this manner, and at every joint the packings (dry stones) had been left in, with the natural result that the joints were all defective. This would not take place if the concrete bed were first formed throughout and the rails laid upon it.

Rails.—The writer is of opinion that the chemical analysis of the rails for straight track and curved track should vary, the straight track being composed of the hardest material consistent with the rails not breaking, and the curves being of considerably softer material for the purpose of bending, and also to prevent undue wear on the wheel flanges. The manufacturers are now making curved rails of manganese steel. The writer has not had any experience with manganese curved rails, but considering the extraordinary wear that takes place on sharp curves at the present time, both on wheel flanges and rail guards, it does seem to him that manganese curved rails are wrong, as the wheel flanges would wear away very much quicker. It is not a very big expense to take out a couple of curved rails and replace them with new ones when required. The writer is of opinion that this would be very much cheaper than lifting cars and re-tiring car-wheels so frequently. All sharp curves should be laid with an ordinary "T" rail, similar to those used as a rule in car depôts, and a separate guard might be attached to the paving, this paving being ashlar stone laid in cement. This separate guard could be renewed when required without disturbing much of the paving, and without taking up the rails.

Points and Crossings.—The idea of manganese insert plates for crossings originated in America, and in theory it appears good, but in actual practice the writer has found it to be a very costly thing. The plate is made so hard that the rails at each end of the plate are worn down very much sooner than the plate itself, and the wear and tear on wheel flanges become excessive. Would it not be better, instead of having a manganese-steel plate, to have a mild-steel plate or a cast-iron plate made of sufficient toughness to withstand the strain? It is not at all necessary to wedge the plates down in the manner suggested by American engineers. A sufficient bed of spelter should be prepared for the plate to rest upon, and it could be fastened with wedges from the surface, which might be easily removed in case of necessity. The present system of fastening the plates is altogether too difficult to deal with when renewing the plates.

Points are in many cases being made wholly of manganese steel. This, in the opinion of the writer, is wrong. Wherever manganese is used, it is a terrible strain upon wheel flanges and tires. The manganese does not wear at the same rate as the adjoining rails, and when these get worn down at the ends "knocking" occurs. The curved switch is all right, but if made of manganese the same wheel-flange grinding occurs, and the writer has seen a strip $\frac{1}{16}$ in. thick and 15 in. long actually pared from a wheel flange by a manganese switch. In the writer's opinion, cast-steel box points with wrought-steel tongues and renewable plates of mild steel, made to the same pattern as the present approved ones, are the proper points to adopt, the reason being that the wear and tear on the wheels of the cars cause far more expense than having to renew the points or the crossing-plates frequently. Again, scrap price can be obtained for old cast-steel, and that is a consideration when taking up old points.

Tie-Bars are very important; the slightest lateral movement of the rails causing irregular gauge tends to do considerable damage to the rolling stock, in addition to causing the cars to oscillate to an objectionable extent.

Joints.—Given that the length of the rail is first bedded solid on a good foundation of concrete, the first trouble that occurs is at the joint; and once the joint becomes loose and defective, then it has a tendency to cause either hogback or a sag anywhere along the rail. The writer has succeeded in perfecting an "adjustable rail joint support," which has now been used for upwards of two years, and which has been reported upon to the Board of Trade. This

device is very simple indeed, and is composed of two steel plates: one 6 in. wide as a base plate, and the other 4 in. wide as a supporting plate. Both these plates are placed on the concrete underneath, and exactly central with the rail joint. The 4 in. supporting plate is tapped at each end for 1¼ in. screws, and when these screws are turned they bear upon the base plate, lifting the supporting plate and the two ends of the rail to any required position, and maintaining them there. The screws are protected by a stuffing box. In using this device, short, flat, steel fish-plates may be used, these to fit close against the web of the rail, as they are not required to take any vertical strain, being there simply for the purpose of keeping the rails in alignment and to act as washers. Shorter bonds may also be used at the joint. The device is the exact opposite to the so-called "anchor joint," of which the writer has had considerable and sad experience. This device has proved an instant cure for "knocking" joints in old track and a preventative in new track.

Paving.—Sett paving of some description is the best and most satisfactory finish to a tramway track. There are English quarries supplying a good hard stone suitable for paving setts. Extraordinary wear takes place against the tramway rails that would not take place if the rails were not there, but one cannot help thinking that economy would result in putting hard setts against the rails and local setts between.

The writer could never clearly see the justice of tramway authorities first providing, in some cases, one-half the street with the best possible paving, and then being compelled to maintain it. This tells very hard on small concerns, and it would be an assistance to these tramways if such maintenance were carried out at the cost of the highways or other department of the corporation.

The writer is firmly convinced from practical experience that anchoring, except in very special cases, is an unnecessary expense.

Corrugations.—The writer has had no actual experience of this trouble, but has little doubt that the trouble originates at the rolling mill. This conclusion may be reasonably arrived at by the fact that the corrugation occurs at any place along the tramway route; on straight track, on curves, on inclines and declines. If it could be located to one particular or similar place always, a pertinent question would be: "Is this where the magnetic brake is always applied?"

Discussion.

Mr. H. Mozley, of Burnley, opening the discussion on Mr. Bullough's paper, said that in that town they had had a great deal of trouble with broken axles; he thought much of this was due to the malformation of their passing-places on the single line, and that they should have an absolutely straight lead into the points—the curve should begin at the heel of the points. He did not agree at all with Mr. Bullough's statement that the corrugation trouble originated at the rolling mill. At Burnley they still thought that it originated in the action of the rolling stock.

Mr. Moffatt, of Rochdale, said he had had experience of both ways of dealing with the concrete, and he thought the best thing to do was to pack the rails up and put the concrete in afterwards. The packing which was put in after the concrete had set very often disintegrated, water got in and washed it away, and they had a subsiding rail. He was of opinion that it was more costly to pull up permanent way than it was to turn the tires. They should keep the permanent way down as long as they could, because as soon as they began to repair they would find that it was going to pieces all the time. In regard to points he was against the renewable plate because they could not retemper a renewable plate of such small dimensions as well as they could retemper the large point. He believed the Americans were now giving up the renewable plate and were trying to temper the crossing to a very high temper in the centre. In regard to anchoring, if they were going in for a concrete foundation, the best thing was to try and make the rails and bed one whole, anchoring down as much as possible, and not letting there be any vibration, because they would get the necessary elasticity in the depth of the rail.

Mr. R. B. Holt, of Leeds, said that the toughest and most durable metal should be used in all positions where the track was subjected to hard usage, and the most suitable material for this purpose was manganese steel. The very fact that "extraordinary wear" took place on sharp curves, clearly showed that the rails were too soft and that there was need of a tougher rail. Soft rails wore so rapidly, and were cut away so much by the "machine tool" action of the wheel flanges that cut for themselves mounting steps in both the rail head and the cheek, that a derailment was always probable. The cost of renewing a couple of curved rails in a solitary instance, and on a simple curve, would certainly not be excessive, but if softer rails were used, the frequency of the renewal of many such rails would be anything but pleasant to the general manager when drawing up his balance-sheet. Again, where the curves formed part of a junction, the cost of which might be anything between £100 and £1,000, the cost of relaying the curves would more than counterbalance any expenditure upon wheel tires. But, regarding wheels, he was not aware that good tires suffered to such an extent as Mr. Bullough would infer. In Leeds, where the service was of the heaviest kind, the wheels ran on an average over 60,000 miles before re-tiring, and some wheels had run 82,000 miles without any damage to the flanges, and the curves were both frequent and sharp. The wheel treads were 2½ in. thick when new, and were worn down to ⅝ in. He had not heard of a wheel tire being stripped, as mentioned by Mr. Bullough, but he had many times picked up long pieces of metal which had been sheared from the rail head by the wheel flanges. In regard to renewable inserts of hardened or manganese steels, he had from experience formed the same objection to these plates as Mr. Bullough, but from a different standpoint. For example, Mr. Bullough considered the horizontal wear of the rail, but overlooked the vertical wear, *i.e.*, the wear along the running side of the head. He considered the principle of having steels of different wearing qualities on the same curve a bad principle (taking a vertical aspect), for whether the insert plates were harder or softer than the rail, the wear was uneven, and caused an unsightly and destructive motion to the path of the car, straining the whole of the framework, owing to the opposition offered to the progress of the wheels by the harder or softer inserts, which had either not worn so rapidly or had worn quicker than the rest of the rail. His opinion was that no inserts were really satisfactory, and that softer plates would wear so rapidly as to become a nuisance in the renewal thereof. Manganese steel could not be drilled commercially, but bolt holes might be electrically burnt through it, and so far he had contrived to make all the alterations he had found necessary in manganese points and crossings. Regarding welded joints, he had under his charge at the present time 11,000 Thermit welded joints, over one-half of which he had personally inspected, and he could assure Mr. Bullough that on those points which were on new rails and laid during the last three years there were no indications of "hammering." It was absolutely necessary that the rail ends should be true; otherwise, if a gap was left at the surface, the "hammering" action was sure to commence.

Alderman Travis, of Southport, said their experience at Southport in regard to the relative value of cast iron and manganese points and crossings was that manganese lasted longer than cast-iron.

Mr. Monk, of Plymouth, said his committee had tried Thermit welding for 12 months and found it very satisfactory.

Mr. Bullough, in replying to the discussion, said that as to the difference of opinion about the concrete, the Manchester track, which he considered as good as any in the world up to the present moment, was laid with all the concrete laid first. He said this was wrong, and was only due to the fact that the contractors wanted to do the work as cheaply as possible. He would rather renew the rails every two years than take the cars into the shed every two or three months to renew the tires. The renewing of the rails would be cheaper for his system, but it must not be supposed that he suggested that this would be the case on all tramways or on every curve. The facts must be ascertained in each instance. With regard to anchor joints, a cover plate, whether it were an ordinary flat plate, joist or inverted rail, if properly riveted to the flanges of the two rails, would strengthen the joint in proportion to the depth of the plate, but he failed to see that any appreciable anchoring resulted. If the under rail were not inverted, but placed with the flange down, anchoring would be effected by the amount of concrete on the flange, which would be about 5½ in., and this, in his opinion, would be negligible; at present they were relying for anchorage on the head and web of the inverted rail, which was practically nil. But why attempt to anchor the joint down? Surely the tendency of the rail ends was to go down always, and he was firmly of opinion that the joint should be supported, and that this might be done most effectively by the device described in his paper. He had never seen a joint between the rail and the paving which was perfect in respect of keeping the water out. In regard to permanent way work they had hitherto been in the hands of the manufacturers, but the time had now arrived when they, as tramway managers, should be in a position to say what they wanted and to see that they got it.

Depreciation and Renewals Funds in Relation to Tramways Undertakings.

By G. W. Holford (General Manager, Salford Corporation Tramways).

(*Abstract of Paper read on September 20th*, 1906.)

Having recently had occasion to report to my Committee with reference to our depreciation and renewals fund, I forwarded to my colleagues, who have charge of the several undertakings in the country, certain queries upon the subject generally, and it was afterwards suggested to me that, as the matter was one of very great importance to all those interested in municipal tramway work, this meeting of the Association would form a fitting opportunity to introduce a discussion on the subject, and to lay before the members of the Association in tabulated form the information which had been so kindly supplied to me.

I do not refer to depreciation in the same manner as it is usually dealt with in the balance-sheet of a tramway undertaking, but more especially with regard to the provision of a fund to cover the cost of renewals which will be required in a *municipal* tramway undertaking before the period for which the borrowing powers have been allowed has expired.

With regard to rolling stock, buildings, and overhead equipment, I submit that it is not necessary for a municipal tramways undertaking to establish a special renewals fund.

I, therefore, confine my paper to the subject of the renewal of the tramway track or permanent way.

The two main points to be taken into consideration in dealing with this question are:—

1. The probable life of the rails;
2. The probable cost of renewing the metals and relaying the track.

From a perusal of the replies which I received, and which will be found in Appendix A, it will be noticed that the life of rails is a point upon which but few managers desire to venture an

opinion at present; but as far as I could gather from the opinions expressed, the life of the rails is estimated at, approximately, twelve years.

In connection with the Congress of the International Tramway Association at Milan in the present month, a number of queries were issued to the various tramway authorities on the Continent; from a perusal of the replies it is found that the general estimate of the life of a rail over which the traffic is fairly light—that is, not less than every five minutes—would average out at about 15 years, and that on a line where the traffic is heavy at about ten years. After a careful study of the subject, and from a number of measurements I have had taken of the wear on numerous portions of our rails, I came to the conclusion that these figures were the most desirable to adopt.

Before leaving this portion of the subject, I desire to specially mention two points which came to my notice; first, the excess in wear at the rail ends as compared with that about 3 ft. away; and secondly, that in grinding the rails to take out corrugation we had to reduce the thickness by nearly one-sixteenth of an inch, which means a lessening of the life of the rail of probably one year, and if the corrugation returns this may possibly have an important bearing on the question of the date at which the renewals will be required.

With regard to excessive wear at the rail ends, the means we have so far adopted in dealing with this is to weld the joint by the Thermit process.

On the question of the probable cost that will be incurred in providing new rails, &c., and in relaying the track, I am able to speak with a greater degree of certainty, as the laying of practically the whole of our tramway track was carried out under the immediate control of the department, and a careful record kept of the same. It was found that for reconstruction work, with a concrete bed throughout and using new granite setts, the average cost was about £6,500 per mile of single track. In the case where new setts were not used, the cost was approximately £4,930 per mile of single track.

It should be borne in mind that it will not be necessary to reconstruct a new concrete bed throughout, and in consideration of this fact the cost of the work will be lessened by, approximately, a further sum of £600, leaving the amount at £4,330; but this will be further reduced, as the old rails taken up will certainly be worth, as scrap material, not less than £2 per ton, and as there will be approximately 160 tons of metal to be taken from each single mile of track, a further reduction will take place to the extent of £320, leaving the net cost of the work at £4,010—say £4,000—which I consider is a fairly high figure, and no doubt may possibly be still further reduced when the time arrives to carry out the work.

Taking this figure for our calculation means that, in order to provide an adequate fund for the future expenditure to be incurred in the renewal of the track, it is necessary and desirable to set aside annually a sum of £400 in respect of each single mile of tramway with an estimated life of ten years, and £267 in respect of each mile of tramway with an estimated life of 15 years.

I desire to call attention particularly to the varied methods which have been adopted by several tramway undertakings in dealing with the establishment of a depreciation and renewals fund. In several instances, I feel sure that ample provision is being made for the expenditure that will have to be met in a few years' time; in other instances, the authorities have been of a perhaps too generous spirit, and whilst making handsome contributions to the relief of the rates in their respective cities and towns, have hardly dealt as they ought with the provision of an adequate depreciation and renewals fund. Many undertakings, particularly the smaller ones, have so far been unable to establish any fund. In conclusion, I desire to earnestly impress upon those gentlemen responsible for the control of the undertakings in which proper provision is not being made the very serious results which will follow in some 10 or 12 years' time, when, owing to the non-provision or insufficient provision of such a fund, heavy calls will inevitably have to be made upon the ratepayers to meet the requisite expenditure for the work, causing great dissatisfaction, and, no doubt, strong adverse criticism of municipal management, which may result in a serious set-back to municipal progress for many years to follow.

Discussion.

Alderman McCormick, of Belfast, said that Mr. Holford's doctrine, in regard to overhead equipment, would meet with general approval, but he found some difficulty in agreeing with Mr. Holford in his policy in regard to permanent way. The setting aside of a sum of £400 per mile per year for depreciation of permanent way would impose upon Belfast the very serious charge of £28,000 per year. There would be a great deal less wear and tear on lines in the suburbs than on lines in the centre, and surely £200 per mile would be sufficient for some parts.

Mr. Monk, of Plymouth, said that their possibilities in regard to depreciation depended largely on what they paid for current. At

APPENDIX A (Abbreviated).

Showing the Provision Made by Tramway Undertakings with regard to a Depreciation and Renewals Fund.

Town.	No. of cars.	No. of miles of track.	Annual contribution to depreciation and renewals fund.	Total amount of such fund at March 31, 1906.	Estimated life of Rails.	Cars.	Overhead.
Aberdeen ...	69	27¾	Whole of net profits	£14,379	15	15	15
Ayr	17	7½	3 per cent., less cost of renewals	£9,021	—	—	—
Birkenhead ...	59	23½	Whole of net profits	£11,466	—	—	—
Bolton	86	42	Track, £360 per mile; overhead, 5 per cent.; cars, &c., 10 per cent.; depôts, 3 per cent.	£33,928	12½	10	20
Bradford ...	239	96	Whole of net profits	£48,469	15—12	Can be maintained out of revenue.	
Brighton ...	50	17	Whole of net profits	£2,766	Cannot say	Can be maintained out of revenue.	
Burnley ...	46	19½	Whole of net profits	£11,797	—	—	—
Bury	41	23	Whole of net profits	£4,343	15	Can be maintained out of revenue.	
Darwen... ...	15	7½	£170 for cars	£5,250	20—15	15	Wire 7; poles 25
Derby	39	8¾	Intended to use all profits	£6,529	—	—	—
Dundee... ...	54	12½	No fixed amount	£20,992	—	—	—
Glasgow ...	783	158¾	Track, £500 per mile; poles, &c., 3 per cent.; cars, 7½ per cent.; depôts, 2½ per cent.	£905,254	—	—	Maintained out of revenue.
Halifax... ...	96	52	Whole of net profits	£10,221	—	—	—
Huddersfield ...	70	30	3 per cent. of total capital expenditure	£44,268	12	15	10
Hull	116	27	No fixed amount	£63,000	—	—	—
Kirkcaldy ...	22	7½	3 per cent. on cars and tools	£858	Under consideration.		
Leeds	270	94¾	Track, £11,565; overhead, 2½ per cent.; cars, 5 per cent.; depôts, nil	£118,493	—	—	—
Leicester ...	140	36¾	Whole of net profits	£27,558	—	—	—
Liverpool ...	479	103	No fixed amount; £50,639 set aside last year	£214,398	Consider these amounts sufficient.		
Manchester ...	542	142	Track, £400 per mile; overhead, £50 ditto; cars, 5 per cent.; depôts, nil	£249,212	10	20	Maintained out of revenue
Newcastle ...	187	57½	No fixed amount	£28,658	12	Maintained out of revenue.	
Preston... ...	30	14	All net profits to reserve fund	£4,000	—	—	—
Reading ...	36	13¼	Whole of net profits	£5,115	—	—	—
Rotherham ...	30	7	Whole of net profits	£4,980	5 per cent. on whole sufficient.		
Salford	175	54¾	No fixed amount	£30,439	15—10	Maintained out of revenue.	
Sheffield ...	257	66	£20,000	£108,479	12—7	Equipment 6	Line 6
Southampton ...	49	16	Whole of net profits	Not stated	12	18	Line 8
Southport ...	26	19½	£1,053	£5,477	—	—	—
Stockport ...	45	25	Whole of net profits	£5,941	—	—	—
Sunderland ...	64	19½	£6,400	£25,166	—	—	—
Wallasey ...	35	12	1·47d. per car-mile	£15,466	—	—	—
Walsall... ...	28	17½	Whole of net profits	£6,163	—	—	—
Warrington ...	21	6½	Whole of net profits	£220	—	—	—
West Ham ...	93	26	No fixed amount	£10,092	—	—	—
Wolverhampton	40	20	No fixed amount	£13,498	12	10	Lorain system.

Ashton, Barking, Blackburn, Bournemouth, Chester, Colchester, Darlington, Doncaster, Gloucester, Keighley, Kilmarnock, Lincoln, Lowestoft, Maidstone, Pontypridd, Rochdale, Southend and Wigan make no annual allowance for renewals; Blackpool, Great Yarmouth, Ilford, Newport, Northampton and Oldham make no fixed allowance, but have renewals funds varying up to £6,342.

Plymouth they were paying 2d. per unit, whereas he understood that in some places the charge was as low as ½d. He really doubted whether it was necessary, after paying interest and sinking fund, and keeping up the repair of the line all out of revenue, to provide a depreciation fund also.

Councillor Flint, of Leicester, said that municipalities which were not making any provision for depreciation were simply preparing a rod for their own backs. They did not know yet how great their responsibilities would be, and it was their duty to provide against anything which might arise.

Mr. Fisher, of Dundee, strongly urged that every effort should be made to put tramway undertakings on a sound financial basis. In Dundee they had argued before the assessors, that £400 per mile of single track, was the correct sum required for renewals.

Mr. Stephen Sellon, of London, who was present as representing the Tramways and Light Railways Association, said that he much preferred the view taken by Mr. Holford to that of the Belfast representative, but instead of actually putting aside £400 per mile, he should calculate the sum which when put out at 3½ per cent. interest, would make the amount necessary for that purpose. A great mistake appeared to be made in regard to the meaning of the words "sinking fund." A sinking fund was not, and never could be, a depreciation fund. It simply meant that a sum of money was put aside so that when the term of years expired for which a sum of money had been borrowed, it had been repaid. Depreciation was a totally different thing, because it meant money for renewing all their material before that date had expired. If they borrowed money for twenty years, some of their materials would necessarily be worn out before that date, and therefore the renewal or depreciation fund was absolutely necessary, quite apart from the sinking fund.

Mr. Blain, of West Ham, said it seemed to him that so far as the reserve and renewal fund was concerned, it should be sufficient for that fund to be accumulated to a sufficient extent to cover the cost of any portion of the plant, the actual life of which will expire in less than the period for which the borrowing had taken place. He did not think it would be considered, for a moment, that there was any likelihood of any demand being made upon the reserve fund for the overhead equipment. That would be maintained every year out of revenue. Even in regard to cars, there should not be a great outlay necessary within the period for which the loan had been borrowed. The permanent way was the principal item, and it must be safeguarded, but the figure of £400 per mile seemed to him to be very high for permanent way which had been laid down under the conditions of modern practice. Would not £300 with compound interest be considered to be quite sufficient to cover depreciation of permanent way, and might not the other items very well be left to take care of themselves out of the ordinary revenue account?

Mr. J. Dalrymple, of Glasgow, said his Corporation had never set aside one single penny more than they considered necessary to meet renewals and depreciation. If he, as an individual, borrowed £1,000 to start business, he must pay that back again before he was a free man, and he thought it was the first duty of a corporation to free itself of debt, because the business did not belong to it until it had done so.

Mr. Nance, of Belfast, protested against the principle of robbing the present generation for the sake of a future generation; let them put aside enough only to make themselves safe. Whilst they must have a sum which should be inviolate for renewals of permanent way, there was no advantage in setting aside too large a sum; £200 per year was a very safe sum to put aside.

Mr. Courtis, of Cardiff, suggested that there should be a general understanding that members might contribute to the discussion by letter to the secretary, the time being short and the president, said Mr. Holford, would also deal in the same way with his reply.

Votes of thanks were passed to the Lord Mayor of Leeds, the chairman and deputy-chairman of the Tramways Committee, and the Corporation for their hospitality and the use of the rooms, and to Mr. Hamilton for his services as President.

These were acknowledged, and the proceedings were concluded.

AVAILABLE POWER FROM BLAST FURNACE PLANT.

In a communication to the Western Society of Engineers, Mr. H. Freyn gives figures of blast furnace gas power that are very complete and useful. He takes the American consumption of coal as 1.900 lb. per ton of pig (? 2,000 lb. ton), so that a pair of 400-ton blast furnaces will use 1,520,000 lb. of coke daily, and this will produce 110 million cb. ft. of gas, or 137,000 cb. ft. of gas per ton of pig, of an average heat value of 90 B.TH.U. per cb. ft., or a total heat value per 24 hours of 391,500,000 units.

At full load a large modern gas engine uses less than 9,000 units per B.H.P.-hour, so that if all the gas were to be used for power purposes it would give 50 H.P. per ton of pig per 24 hours. In the earliest test made of blast furnace gas by W. H. Booth on a small engine at Wishaw, the gas per E.H.P. at the switchboard, when the engine was doing about 60 per cent. of full load, was about 140 cb. ft. per ton, or, say, 12,600 B.TH.U., assuming 90 B.TH.U. per ft. At 90 per cent. efficiency, this represents 11,340 B.TH.U. per B.H.P.-hour, which is practically equivalent to the results of to-day, after taking into consideration the small engine and the fact of its underloading, and this emphasises the extremely regular quality of the gas from furnaces of widely different size and methods of working, for all subsequent tests have departed very little from this early test on the pioneer engine of Thwaite.

The author divides the total gas production as follows: Half for hot blast stoves, gas blowing engines, auxiliary machinery about the works and lighting, cleaning plant and loss; and the remaining gas for external purposes. Usually about 30 per cent. of the total gas is used in the stoves. Wehling, however, puts the figure at 18 per cent., others at 25 per cent., and 30 per cent. will certainly not be exceeded if it be considered that when all the gas is cleaned the efficiency of the stoves will be greatly improved, for stoves are very seriously impaired in efficiency by the dust which enters them with the gas. Indeed, Thwaite has long advised that stoves should only be supplied with cleaned gas.

New furnace plant will, it is anticipated, be supplied with one steam blowing plant for starting up, and all the rest will be done by gas power. Blast is required at the rate of 90 ft. per minute per ton of pig per day. Its pressure is 15 to 18 lb. per sq. in. as usual in American practice, but occasionally it may reach 30 lb., and the power must be ample, for to compress 100 cb. ft. per minute to 30 lb. will demand nearly 10 B.H.P. in the gas engine. This means 7,200 B.H.P. for the two furnaces. For 15 lb. pressure 6 H.P. will be needed per 100 cb. ft. per minute, or 4,320 H.P. as a minimum, so that normally the engines will work at 60 per cent. of full load, at which probably their heat consumption would be 11,000 B.TH.U. per B.H.P. per hour. This works out to a figure 170,000 cb. ft. per hour less than the 720,000 ft. which will be the maximum. Auxiliary plant is allotted 120,000 cb. ft. All the gas produced would be cleaned to a dust limit of 0·5 grain per metre cube, while that for use in engines would be further cleaned to 0·03 grain = 0·0131 grain per cubic foot. Gas thus far cleaned will enable an engine to run six months, day and night, without internal cleaning. The author seems only to know the Thiesen washer, but the box washer, as devised by Thwaite, gives, we believe, more perfect cleansing in conjunction with the centrifugal fan and water spray to keep the fan clean. We believe this system is used in Germany in many of the most successful blast furnace plants, and that it uses less water than the Thiesen system.

The author contemplates the stoppage of the supply of gas, should the market for pig become slack, but if the gas is needed it is surely not necessary to stop a furnace. The supply of ore can be stopped, and no pig made, but gas can be made if the supply of fuel is kept up, and iron smelting resumed when a demand for iron again arises. But seeing that the blast furnace is an ideal producer and that the gas is required, why not continue to make pig iron as a by-product, even if not saleable immediately? Its making under such circumstances will cost less than if the furnace is merely run for gas, and pig-iron will always sell some day, for periods of heavy demand recur.

Estimating the cost of a plant of 10,000 B.H.P. capacity, the author proposes eight double tandem 38 in. × 54 in. × 85 R.P.M. engines rated at 1,750 I.H.P. or 1,500 B.H.P. each, direct connected to 800-KW. three-phase 25-cycle 6,600-volt generators with exciters and switchboard complete, including gas-cleaning plant, buildings, foundations, piping, air compressors, and all necessary accessories complete for £148,200, or £12·32 per B.H.P. for 12,000 B.H.P. total capacity, or £17·90 per KW. for 8,300 total. He advises a 48-in. gas main round the engine house, whence the engines would draw gas. This ring main seems to us to be unnecessary. A single main reduced in steps at each point of take-off should be sufficient.

Regulation is proposed by admitting a variable quantity of a constant mixture, following a certain volume of air, so as to give constant compression, and the engines proposed should work with 9,000, 10,000 and 12,600 B.TH.U. per B.H.P.-hour at full, three-quarter and half-load.

Air compressors would supply a maximum of 150 ft. of free air per minute, compressed to 150 lb. for starting purposes.

The operating expenses, including fixed charges, water, lubrication, repairs, wages, &c., and fuel have been made on three assumptions of full load for a year of 10,500 B.H.P., three-quarter load of 8,000 B.H.P. and half-load, a year being 365 days of 24 hours. The fixed charges are worked out at 0·1575 cent, 0·2076 cent and 0·3171 cent per KW.-hour for the three cases, or in pence 0·07875, 0·1038 and 0·1585. Water runs out at 0·01437d. per KW.-hour at full-load, for all purposes, 0·01757d. at three-quarter-load, and 0·02118d. at half-load. Lubrication works out at 0·0123d., 0·01461d. and 0·021095d. respectively at the three-loads; repairs at 0·01417, 0·01681 and 0·02426d.; wages and salaries at 0·02783, 0·03476 and 0·0501; and fuel at 0·0724, 0·08145 and 0·0974d., assuming the price of gas to be ½d. per 1,000 cb. ft. The cost of a B.H.P.-year, will be £3·58, not including the cost of gas.

Taking actual facts as accomplished, the cost per KW-hour at Seraing fell from 0·88d. in 1900 to 0·206d. in 1905, the increased output being from 1,789,281 to 9,999,211 units, in the five years, the cost dropping steadily as the plant capacity was increased. In 1901, when only 900 KW. of plant was installed, the money invested amounted to £30 per KW.; in 1905, with 2,000 KW. installed, the investment per KW. was only £23, and it is properly argued that though the figures cannot be applied directly to American conditions, they are conclusive proof of what can be done in the utilisation of waste gas. Meantime, our British ironmasters are too rich or too satisfied with the profits they are making to pay serious attention to the fortune that slips away before their eyes; and Great Britain, in which the pioneer movement was made, possesses so little in the shape of blast furnace plant that in this American paper small mention is made of this country, and all our big gas engines appear to be built on foreign models. Indeed, there is a reference to Great Britain, for it is noted that a certain English firm are licensees for a certain Belgian engine. Altogether, this is a good paper, and shows that Americans are alive to the advantages of the use of waste products.

THE WORKMEN'S COMPENSATION BILL (1906).

Extension to all Workmen in the Electrical Trades.

By J. DUNCAN, M.A., LL.B., Barrister-at-Law.

The Workmen's Compensation Act of 1897, at present in existence, does not apply to all workmen in the electrical trades. It applies to workmen engaged in (1) electric generating stations, to workmen engaged in electric employment on (2) a railway, (3) mine, (4) quarry, (5) engineering work, (6) building 30 ft. high being constructed or repaired by means of a scaffolding or being demolished or on which machinery driven by steam, water, or other motive power, is being used for the construction, repair, or demolition thereof, (7) factory which includes dock, wharf, quay, warehouse, and electrical station, and all machinery or plant used in the process of loading or unloading or coaling any ship in any dock, harbour or canal, and to any premises on which machinery worked by steam, water or other motive power is temporarily used for the purpose of the construction of a building, and (8) to workmen engaged in electrical employment in agriculture.

Notwithstanding this exhaustive enumeration, there are a number of accidents to workmen in electrical trades which do not fall within the present law, for example, an accident due to cutting the wires to stop a conflagration in the bus-bar boxes (Kidd *v.* The Charing Cross and Strand Electric Co.), or an accident due to falling from a telephone pole 30 ft. high, being repaired with the aid of the cross-bars and a waist-belt (Deacon *v.* National Telephone Co.). Again, the present law does not apply to the undertakers in the eight employments above mentioned if the electrical work is carried on by a contractor, and such work is merely auxiliary or incidental to, and is no part of, or process in, the trade or business carried on by the undertakers. The only right over is against the employer, if he is also an undertaker.

The new Bill makes the employer equally liable with the undertaker, whether he is undertaker or not.

In addition to all these conditions, the workman, if he proceeds against his own employer as an undertaker (which includes the occupier of a factory), must prove that the said employer was the occupier of his *own* factory. Wryley *v.* Whittaker & Sons ([1902] H.L.A.C., 299).

New Bill.—All these garbled limitations, exceptions and conditions are now to be swept away. The constitution of the United States reserves nine questions for the Imperial Parliament at Washington and delegates the others to the local States. The constitution of Canada delegates specific functions to the States, and reserves the residue to the central Parliament at Toronto. In the same way the old W.C. Act dealt with seven employments, whilst the new Bill proposes to deal with all employments, saving some limitations. The Act of 1907 will apply to all workmen defined as follows :—

Workman does not include any person remunerated by salary at a rate exceeding £250 a year, or a person whose employment is of a casual nature, and who is employed otherwise than for the purposes of the employer's trade or business, or a member of a police force, or an outworker, or a domestic servant, or a member of an employer's family dwelling in his house, but save as aforesaid means any person who has entered into or works under a contract of service or apprenticeship with an employer, whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, is oral or in writing.

This definition will practically include all workmen engaged in electrical trades. The new law does not extend the liability of the employer beyond the limits of his own factory or building, unless the relationship of undertaker (now called "principal") and contractor is established.

Industrial Diseases.—The present law applies to injuries by accident ; the new law is to extend to industrial diseases which are not accidents. This extension has been rendered necessary by a decision in the Court of Appeal, that if a date cannot be ascribed to an injury it is not an accident.

In January, 1894, a report by Chief Inspector R. E. Sprague Oram to the Right Hon. H. H. Asquith, Q.C., M.P., Home Secretary, was published, to the effect that the manufacture of electric accumulators was a dangerous process, dry red lead and dry litharge mixed with dilute sulphuric acid being rubbed into embossed or perforated leaden plates with the hands, and the Committee made recommendations under the Factory Act of 1891, Secs. 8 and 9, now Sec. 85 of the Act of 1901.

The present regulations date from January 2nd, 1894, and prescribe a duty on the occupier to supply appliances, and a duty on the workpeople to use these appliances under penalties. These are baths and lavatory accommodation with hot and cold water, soap, nail brushes and towels, respirators, overall suits, gloves and aprons.

No special rules have been laid down with regard to electrical stations for generating or transforming electricity made a factory by the Act of 1901. There does not seem to have become manifest any electrical disease up to the present such as is generated by the constant use of the Röntgen rays. Any inclusion of the electric trades under the heading of Industrial Diseases for the purpose of Sec. 8 of the future Workmen's Compensation Act of 1907, may, therefore, fall under the generic disease of "Plumbism," more prevalent amongst the enamellers of the Potteries, and the whitelead workers, one of the provisions applicable to whom is a sanitary drink containing sulphate of magnesia, and a dose of the prescribed medicine on feeling unwell.

Electrical Trades' Diseases.

Electric Accumulator Works.—The mixing of the dry litharge and of dry red lead raises a dust that is dangerous on inhalation. When the india-rubber gloves get worn or torn, lead is absorbed through the pores of the hands, leading to lead poisoning. The men look pale, suffer from headache and colic, and show a blue line on the gums. The incidence of plumbism in Germany, according to returns made to the Chancellor, is as follows :—

Occupation.	Numbers.	Cases of lead poisoning.	Per cent.
Casting	30	3	10
Pasting	30	9	30
Soldering	16	6	37·5
Trimming	30	4	13·3
Plumbing	30	9	30
Section building ...	60	5	8·3

1. In casting, an oxide of lead fume arises in melting. A hood was recommended. Traces of antimony and arsenic were discernible, the latter varying from ·1 to 7·9 per cent.

2. In pasting, the floor should be kept damp, and the mixing with the sulphuric acid should be carried on in a separate chamber under an exhaust.

3. The remedy as to short gloves is to reduce the spell of work to six hours a day.

4. In soldering, the volatilisation of the lead causes the danger of lead poisoning.

The presence of lead in the air can be determined by suspending a sheet of moistened blotting paper for a time and thereafter treating it with sulphuretted hydrogen.

Motor-Cars.—Dr. Proust has reported four cases of lead poisoning in Paris in women of the ages 18, 19, 25 and 39, whose work consisted in coating with oxide of lead small leaden rods. The symptoms developed within two months. The employers supplied the workers with honey and sulphur, iron pills and half a litre of milk daily, and sulphur baths.

Electric Tramways, Cars and 'Buses.—On October 8th, 1901, a dozen travellers in Paris were seized with violent pains in the abdomen, and syncope, and were obliged to be treated at a chemist's shop. The opinion was expressed that the symptoms were due to poisoning from fumes of sulphuric acid acting upon the lead of the accumulators.

The drivers and conductors of accumulator cars may be subject to this. There is also a new disease developing amongst chaffeurs due to the extreme tension of the mind and muscles in driving. It may be called motoritis, in the absence of a better name. (See further Oliver's "Dangerous Trades.")

Danger in Electrical Trades.—Workmen are liable to accidents in the electric trades in an increasing variety of ways due to the new uses to which electricity is being adapted. In repairing wires, in cleaning machinery, and by accidental contact with charged parts of dynamos, workmen have received

shocks that have proved immediately fatal. More frequently the injuries are burns and shocks leading to temporary disablement. Contact with 1,000 volts exposes the workman to serious risk, and death has been known to arise from contact with 240 volts. In the case of electric railways with overhead trolley wires, contact with both poles of an alternating-current circuit where the pressure exceeded 100 volts has been found to be dangerous, but passengers are not exposed to coming in contact with both the leads, so that the authorities allow 750 volts to be employed. Wearing damp boots, or standing on damp ground increases the danger. India-rubber insulation renders one immune if contact is established with a single object only. Death is due to arrest of breathing or cessation of the heart's action. Artificial respiration may lead to recovery. It should be undertaken immediately and continued for over an hour. (See further, Quain's "Dictionary of Medicine.")

Compulsory Insurance.—A new provision of far-reaching consequences is introduced with regard to trades in which industrial diseases are liable to be endangered and other dangerous trades, namely, the principle of compulsory insurance. The Secretary of State shall have power to embody clauses compelling every employer engaged in any dangerous industry under penalties to insure his workpeople in any mutual trade insurance scheme which is confined to that industry.

Minors.—Minors are to have 100 per cent. compensation instead of 50, but not more than 10s. a week nor 50 per cent. of the earnings of an adult.

Casuals.—The employment has to be continuous over two weeks before compensation can be accorded; this abolishes compensation to casuals at present existing.

The law has, however, been extended in another direction; the period of quarantine is reduced from 14 days to three days, a reduction carried by the Committee against the wishes of the Home Secretary, Mr. Gladstone.

Injuries by electricity caused to merchant seamen, but not seamen of the Royal Navy, are also included under the Bill. Touching live wires is not an uncommon occurrence amongst sailors. In such case the ship, if registered in the United Kingdom, can be detained pending security for compensation.

Although the premium payable to the insurers will be heavier in future, it does not seem that the percentage should be higher, as the most dangerous of the electric occupations, namely, at generating stations, is already within the law.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c, may be made. Answers are furnished by a duly qualified lawyer.*]

"Nun" writes:—"I am an electrical contractor in this city, and recently completed the installation of electric wiring in four villas for a local builder. My contract was that I should wire these villas up to the switches and ceilings with 600-megohm cable in Simplex split tubing. It was further stipulated that I should be given the connecting up of the fittings when the villas were tenanted. After completing the above installations up to the switches and ceilings, I tested and found each and all of them satisfactory, and received certain payment on account from the builder.

"For some reason or other these villas were untenanted for a period of nine months, and after the expiration of this time, the builder instructed another contractor to proceed with the fittings and switches in one of the villas. This contractor completed the installation, but after doing so it was found that the test was not sufficiently high to meet the requirements of the supply company, and in consequence I was requested to make good the installation. This I decline to do in view of the fact that, first, the villas had so long since been wired; and, secondly, that my terms were not carried out, in so far as I was not given an opportunity of connecting up the fittings myself.

"The points upon which I should like your advice are:—(1) Do you consider nine months a reasonable time to allow to elapse in a new building before connecting up and testing?

(2) Do you consider that I am legally responsible for the installation which has been finished by another contractor?"

*** "Nun" does not say whether his contract with the builder was in writing or not; if it was it would be well for him to submit a copy, in order that the exact terms may be appreciated. It would seem, however, that on the facts as stated, the builder has committed a breach in not employing "Nun" to wire the villa in question. It has been decided, in an unreported case, that where a man is employed to do a certain piece of work, and without his leave or licence another person is called in to do it, the original contract cannot be enforced.

With regard to question (1), it is conceived that 9 months would not be an unreasonable time unless it could be shown that the wires, &c., would be likely to deteriorate during that period. In view of the fact that another contractor has been employed, however, it is thought that the attitude adopted by "Nun" is quite reasonable. To question (2) the reply is "No."

"Burgh" writes:—"I shall be obliged if you will inform me, through your legal column, if the only way for a municipality to obtain powers to carry out assisted wiring or lamp maintenance is by Act of Parliament."

*** It is clear that in the case of a municipal corporation, their powers in relation to the supply of electricity are delimited by their provisional order. Unless that order specifically provided for "assisted wiring" or "lamp maintenance," it would be *ultra vires* of the corporation to do either. Of course, Sec. 55 of the Schedule to the Electric Lighting Clauses Act, 1899, provides that undertakers may let for hire meters, and any fittings thereto, but special provision must be made for wiring and lamps. Instance the Nottingham Corporation Act, 1899 (62 and 63 Vict. c. ci), Sec. 40, where the power conferred is "to let, &c., but not manufacture lamps, meters, electric lines, fittings, apparatus and things for lighting and motive power, and for all other purposes for which electric energy can or may be used, or otherwise necessary or proper for the supply, distribution, consumption or use, of electric energy."

"H." writes:—"2½ years ago I was appointed, from among a number of applicants, to the position of resident engineer and assistant manager to the tramways system of a certain corporation; the terms of the advertisement, which appeared in the technical Press, being that the position was to start at such and such a salary, rising by five annual increments of £10 to a maximum of so and so. I resigned from a permanent position, the salary of which was slightly less than that of the new position, and expended about £30 in removal expenses (equal to about the difference of salary between the two jobs in 2½ years).

"When I accepted the position there was no agreement signed, but I was appointed under the terms of the advertisement, which led me to suppose that the job was good for six years at least. Now, owing to the fact that the corporation desire to replace salaried officials by 'working men,' I am asked to seek another job, although there is nothing against me personally or my work.

"No definite time is given me, but I am expected to try for every job that is advertised, whether I think it a suitable one or not. Can you give me any advice as to whether I can legally be compelled to acquiesce in this arrangement?"

*** This appears to be an extremely hard case; but looking at it from the strictly legal point of view, it would seem that there is no remedy open to "H." In the first place, a contract made with a corporation is not binding unless made under seal (Hunt *v.* Wimbledon Local Board, 4 C.P.D., 48); and even if the contract referred to were binding, it would seem that the corporation placed themselves under no definite obligation to keep "H" for any particular time.

NEW ELECTRO-CHEMICAL LABORATORY AT LIVERPOOL.

A new laboratory, known as the Muspratt Laboratory of Physical and Electrical Chemistry, the latest addition to the establishment of Liverpool University, is on the point of completion. The erection of the building began in May, 1905. It is the gift of Mr. E. K. Muspratt, of Seaforth Hall, Liverpool, a member of a family long connected with the chemical industry at Liverpool and Widnes. Mr. Muspratt offered the Council of the University the sum of £10,000 to build and equip a chemical laboratory, which, in its main aspects, should be in advance of any laboratory existing in the United Kingdom. The outlay on the laboratory has now reached the sum of £14,000. The feature of the equipment is the prominence which has been given to electricity, as an agent in the work to be carried on. The building stands within the grounds of the University, and adjoins the older laboratory for inorganic and organic chemistry. It is faced with pressed red bricks, with liberal dressings of light stone, and has three stories and a basement. The heavier items of the electrical machinery will be housed in a light and lofty room in the basement. These will consist of an 80-kw. motor-alternator, to yield a current of 1,000 amperes at 80 volts, which will supply current transformed to 8,000 amperes, at 10 volts, for an electric furnace. Power for the motor-alternator will be obtained from the supply mains of the Liverpool Corporation. Also there will be a 30-kw. motor-generator to yield direct current at 80 to 100 volts; and a Tudor accumulator of 36 cells, with a separate charging set. Current from the machines and from the battery will be distributed to the different rooms of the laboratory by a system of switchboards. For working purposes 104 benches are being installed. Each of these will command a supply of electricity of variable voltage; the voltages now being arranged

for are 4, 8, 12, 20, 40, 80, 100 and 230 volts. Each floor will be provided with its own switchboard, distributing to the students' benches on that floor. The supply of electricity will be used largely for electrolytic purposes, but also for heating and for power purposes. By the side of each bench will be fixed a fireproof slab, consisting of very highly pressed red unglazed tiles, set in Portland cement and bound together by angle irons firmly keyed to the wall.

The lecture theatre, the main teaching laboratories, the instrument store room, a workshop, a preparation room and a photographic room will be on the first floor. On the second floor there are five spacious and well-lighted rooms, which will be devoted to research by post-graduate students. As far as may be desirable, fume cupboards will be provided, each of which will be fixed in a window space to ensure a supply of daylight.

Fume pipes from the cupboards are carried to the flat roof of the building, where they have an outlet within two domes which form an architectural feature of the structure. Each student will have at command a full supply of gas, water and electricity. Within the rooms distribution has been made on a system to secure the maximum of flexibility. The supply wires are carried below the girders, across rows of small round insulators of porcelain, and are open to view. The wires for each bench are carried down from the wires which lie below the girders overhead, and are all movable. The ceilings of the research rooms have been fitted with wood battens, forming small troughs in which water pipes or electric wires may be fixed for special and occasional work. The floors are of concrete, and each one has been provided with semi-circular conduits of Doulton ware, to carry away water or waste liquids. The conduits are provided with removable coverings, to admit of access to the open conduit at any point. On the roof of the building an open-air laboratory has been erected, in which necessary experiments with poisonous or strongly malodorous substances will be carried out. This laboratory is roofed over, but is otherwise open to the atmosphere. The entire building will be lighted artificially, partly by incandescent gas and partly by tantalum electric lamps.

The electrical machinery is being supplied by Messrs. Siemens Bros., of London, and the switchboards by Mr. H. S. Martin, 13, Cumberland Street, Liverpool, who is carrying out the wiring and other work in connection with the electrical installation. The building will be heated by hot-water radiators, supplied by Messrs. Saunders & Taylor, Manchester. The architects for the building were Messrs. Willink & Thicknesse, Liverpool, and the contractors Messrs. Jones & Son, Liverpool.

The laboratory has been built for the pursuit of physical and electrical chemistry, and for the study of the more modern aspects of chemistry. The old laboratory will continue as the seat of study in organic and inorganic chemistry. The new Muspratt laboratory will be under the direction of Prof. F. G. Donnan.

The formal opening of the Muspratt laboratory has been fixed for October 13th.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

605A. "Improvements in and relating to carcases for dynamo-electric machines." F. H. Loring. (Date applied for under Rule 5 of the Patents Rules, 1905, January 9th, 1906.) September 18th. (Complete.)

20,556. "Improvements in electric arcs." H. S. Hatfield and F. M. Lewis. September 17th.

20,580. "Improvements in starting and regulating switches for use in connection with electro-motors." J. Booker. September 17th. (Complete.)

20,613. "Improvements in and relating to connectors for electric conductors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 17th.

20,623. "Improvements in dynamo-electric machines." J. G. P. Thomas and C. R. McGowan. September 17th.

20,639. "Improvements in moving metallic cylinders from mandrels on which they are electro-deposited." S. O. Cowper-Coles. September 17th.

20,662. "Improvements in electric heaters." T. E. R. Phillips. September 18th.

20,703. "Improvements in electrical resistances." W. J. Davy. September 18th.

20,712. "Improvements relating to the electro-deposition of metals and alloys." D. Roberts, M. K. D. Roberts and E. W. Jaffray. September 18th. (Complete.)

20,716. "Improved method of and apparatus for the electro-deposition of metals and their alloys." D. Roberts, M. K. D. Roberts and E. W. Jaffray. September 18th. (Complete.)

20,719. "Improvements in alternating-current electro-magnets." Felten and Guilleaume-Lahmeyer-Werke Actien-Gesellschaft. (Date applied for under Patents Act, 1901, September 30th, 1905, being date of application in Germany.) September 18th. (Complete.)

20,730. "Improvements relating to the operation of vapour electric lamps." P. H. Thomas. (Date applied for under Patents Act, 1901, September 27th, 1905, being date of application in United States.) September 18th. (Complete.)

20,733. "Improvements relating to conversation counters in telephone installations." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien-Gesellschaft, Germany.) September 18th. (Complete.)

20,752. "Improvements in the mounting of dynamo-electric machines." F. H. Loring. September 19th.

20,764. "Improvements in electric switches." W. F. Jones. September 19th.

20,803. "Improvements in electric motor control devices." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) September 19th.

20,804. "Improvements in and relating to the lubrication of dynamo-electric machines for railways and the like." The British Thomson-Houston Co., Ltd. (Allgemeine Elektrizitäts Gesellschaft, Germany.) September 19th.

20,808. "Improvements in and relating to compensated dynamo-electric machines having commutating poles." Allgemeine Elektrizitats Gesellschaft. (Date applied for under Patents Act, 1901, September 20th, 1905, being date of application in Germany.) September 19th. (Complete.)

20,815. "Improvements in or relating to the production of electric fluid." J. G. Porres. September 19th. (Complete.)

20,835. "Improvements in or relating to electrical illuminated devices for use for advertising or other purposes." A. B. Gregson. September 19th. (Complete.)

20,859. "Improvements in connection with telephone receivers." H. W. Sullivan. September 20th.

20,915. "Improvements in electrical switches and methods of connecting same for the control of lamps or other apparatus." A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. September 20th.

20,928. "Improvements in and relating to systems of operating electric motors for braking purposes." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 20th.

20,929. "Improvements in and relating to insulating studs and the like, and methods of making the same." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 20th.

20,942. "Improvements appertaining to current-collectors for electrically-driven vehicles." J. W. Knowles. September 21st.

20,980. "Improvements in and relating to ignition devices for internal combustion engines and the like." S. Brotherhood and C. W. Bryant. September 21st.

21,001. "Improvements in and relating to devices for controlling electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 21st.

21,002. "Improvements in dynamo-electric machines." J. E. Noeggerath. (Date applied for under Patents Act, 1901, September 22nd, 1905, being date of application in United States.) September 21st., (Complete.)

21,003. "Improvements in and relating to collector rings for dynamo-electric machines." J. E. Noeggerath. (Date applied for under Patents Act, 1901, September 22nd, 1905, being date of application in United States.) September 21st. (Complete.)

21,004. "Improvements in and relating to systems of operating electric motors for braking purposes." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 21st.

21,008. "Improvements in or relating to apparatus for supplying or controlling the current to electrical igniters of explosion engines." A. Gibaud. (Date applied for under Patents Act, 1901, September 22nd, 1905, being date of application in France.) September 21st. (Complete.)

21,029. "Improvements in trolleys and trolley wheels for use in electric or other like cars." J. S. Hilton and T. Taylor. September 22nd.

21,043. "Improvements in or relating to electric batteries." H. W. van Raden and C. B. Robinson. September 22nd.

21,050. "Electric brush-holder of the cartridge type." Veritys, Ltd., and D. E. Rogers. September 22nd. (Complete.)

21,053. "Improvements in electric switches." H. Hirst and H. T. Harrison. September 22nd.

21,059. "Improvements in automatically operating telegraphic mechanism for transmitting pre-determined messages, particularly applicable for fire alarm apparatus." C. Smith. September 22nd.

21,071. "Improvements in vapour electric devices." F. W. Le Tall. (The Cooper-Hewitt Electric Co., United States.) September 22nd.

21,077. "Improved carpet and boots with wiring for electric light displays and the like." H. N. Dakhyl and A. Galanti. September 22nd.

21,081. "Improvements in apparatus for the manufacture of iron tubes by electro-deposition." S. O. Cowper-Coles. September 22nd.

21,089. "Improvements in telegraphy." E. Piotrowsky. September 22nd. (Complete.)

21,091. "Improvements in and relating to electrical switch and like gear." W. Roberts. (J. Roberts, Natal.) September 22nd.

21,094. "Improved arrangement of electric motor-generator for working arc lamps." Siemens Bros.' Dynamo Works, Ltd. (Siemens-Schuckert werke G.m.b.H.) September 22nd. (Complete.)

21,100. "Improvements in or relating to the electrolysis of haloid salts and compounds." E. A. Ashcroft. September 22nd.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Electric Signalling Systems Particularly Applicable to Telephony. British Thomson-Houston Co. (General Electric Co.) 15,196. July 24th.

Controllers for Electric Circuits. M. B. Field and Ferranti, Ltd. 17,699A. (Date applied for under Rule 5, Patents Rules 1905, September 1st, 1905.)

Apparatus for Controlling and Supplying Electric Current for Power and Light on Consumers' Premises During Certain Periods. G. S. Ellis and A. M. Taylor. 17,814. September 4th.

Electric Incandescent Lampholders. T. S. Jones. 18,087. September 7th.

Wireless Telegraphic Apparatus. British Thomson-Houston Co. (General Electric Co.) 19,034. September 20th.

Automatic Transmitters for Electric Telegraphy. W. Judd, A. Fraser and A. R. Hardie. 19,099. September 21st.

Electric Switches or Cut-Outs. British Thomson-Houston Co. (General Electric Co.) 20,599. October 11th.

Dynamo-Electric Machines. A. F. Hills, D. Urquhart and A. E. Honey. 24,877. November 30th.

Electric Traction Systems. E. A. Mitchell and the Dolter Electric Traction, Ltd. 24,963. December 1st.

Telephone Message Tablet with Fall Down Number Register. A. F. Crofts, H. C. Smith and G. E. Wells. 26,528. December 20th.

Method of Increasing the Capacity of Electric Accumulators. M. Roloff. 16,008. August 4th.

Electric Accumulators. H. Warren, G. Busschots and Wood. 17,674. September 1st.

Electro-Deposition of Metals. I. E. Lewis and J. A. Corey. 17,727. September 1st.

Electric Insulators. T. Cushing. 17,997. September 6th.

Electric Motor Control Systems. A. Magnuson. 18,125. September 7th.

Type-Printing Telegraph Transmitters. H. S. F. W. Higgins. 18,694. September 15th.

Method of and Ingredients for the Manufacture of a Substance Suitable for Electrical Insulation. G. Hess. 19,111. September 21st.

Electrically Controlled Semaphore Signals for Railways. F. B. Holt and A. Wallis. 19,568. September 28th.

Electrical Ignition Devices for Internal Combustion Engines. H. C. L. Holden. 21,489. October 2nd.

Method of and Apparatus for Equalising the Output of Main Dynamo-Electric Generators Supplying Energy to a Fluctuating External Load. A. P. Wood and the Lancashire Dynamo and Motor Co. 22,654. November 6th.